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Medical Lib

VOL. XXXIV SEPTEMBER, 1924 No. 9

THE LARYNGOSCOPE

AN INTERNATIONAL MONTHLY JOURNAL
DEVOTED TO DISEASES OF THE

EAR - NOSE - THROAT

FOUNDED IN 1896 BY

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Associate Editor.

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Subscription, $6.00 per Annum, in Advance.

Foreign Subscription, 35 Shillings per Annum, Post Free.
Single Copies, 75 cents.

PUBLISHED BY THE LARYNGOSCOPE CO.

3858 Westminster Place, St. Louis, Mo., U. S. A.

FOREIGN OFFICE, BAILLIERE, TINDALL & COX,
8 HENRIETTA ST., STRAND, LONDON, ENG.

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THE
LARYNGOSCOPE.

Vol. XXXIV ST. LOUIS, SEPTEMBER, 1924. No. 9

ORIGINAL COMMUNICATIONS.

(Original Communications are received with the understanding that they are contributed exclusively to THE LARYNGOSCOPE.)

FUNCTIONAL TESTS OF HEARING.*

DR. ISAAC H. JONES AND DR. VERN O. KNUDSEN, Los Angeles.

As this paper involves the points of view of an otologist and a physicist, it has seemed best to approach it first from the standpoint of otology and second from the standpoint of physics.

FROM THE OTOLOGIC STANDPOINT.

For many years otologists have recognized the inadequacy of the commonly employed tests of auditory function. In such tests, it is of interest to consider what factors would contribute toward the ideal.

The practicing otologist feels the need of some method that is precise and yet requires a minimum amount of time. Much time and patience is necessary to conduct complete functional tests of hearing with the present methods. It would be highly desirable if one could attain simplicity and speed as well as accuracy. Only too frequently the busy practitioner finds himself making only a cursory examination. He would also like to be able to measure progressive changes in hearing. He would like to determine whether any beneficial effect is being produced by his treatment of any given ear condition. We need a "yardstick" of measurement. We have all felt at times that perhaps our main standard is the temperament or disposition of the patient. If the patient is an optimist he will tell us that he is much improved; if he is a pessimist he will tell us that he is no better or worse. Even in prolonged observation of a deaf patient, unless gross changes occur, either for the better or

*To be read before the American Laryngological, Rhinological and Otological Society, in St. Louis, May, 1924.

for the worse, it is difficult to draw any exact conclusions as to the status of the hearing defect.

Again, it would be highly desirable if there could be some attempt at standardization of the hearing tests. By following the same technic, the physician may compare his vestibular findings with those of another examiner in another city on a different date. It is quite a contrast when one receives a letter from some other otologist regarding the tests of hearing that he has made. At times one wonders if there are not almost as many methods of recording functional tests of hearing as there are otologists.

Again, it would be desirable if we could make such tests that we could prescribe the artificial aid for hearing particularly suited to the needs of any given individual.

During the past five years there has been distinct progress owing to the works of certain otologists and physicists, in co-operation. The contributions of these investigators have brought us nearer the ideals as expressed above. Among the pioneer workers of this field are Lee Wallace Dean, Carl S. Seashore and C. C. Bunch, of the University of Iowa, who brought out an instrument for producing tones of different pitch, and provided a means in this instrument for reducing the loudness of the tones to the minimal threshold of audibility. In their audiometer, tones are produced by rotating a toothed wheel in a magnetic field. When the wheel revolves rapidly it produces high tones and when it revolves slowly it produces low tones. Much work has been done recently in the developing and perfecting of audiometers. This development has resulted largely from the elaborate work of the research engineers of the Western Electric Company. Harvey Fletcher and R. L. Wegel, physicists of the Western Electric Company, in co-operation with Dr. E. P. Fowler, have developed an audiometer which uses the audion bulb. Dr. J. Gordon Wilson, and John P. Minton, of Chicago with a similar instrument, have made experimental studies of normal and pathologic cases. Dr. George E. Shambaugh, of Chicago, and Vern O. Knudson, then of Chicago, with the use of a similar instrument, have conducted experimental studies on the sensibility to differences of loudness and pitch and also on diplacusis. Dr. A. G. Pohlman, of St. Louis, and Frederick Kranz, of Geneva, Illinois, with a similar instrument, have studied the effect on auditory acuity of quinine and also of pressure on the drum membrane.

The utilization of the audion bulb is largely responsible for these new developments. This audion bulb or vacuum tube has two principle uses: as an oscillator, and as an amplifier.

Its uses as an oscillator is the basis of the Western Electric audiometer. With the audiometer it is possible to measure the acuity of hearing of a patient for representative bones throughout the range of audibility. The tones are directed, by means of a telephone receiver, to the ear under examination, and then reduced in loudness to the point of minimal audibility.

It occurred to us that in addition to the production of tones, other features could be utilized in making functional tests of hearing:

1. The use of the other feature of the audion bulb—as an amplifier, for the conversational voice and whisper.

2. Selective amplification in testing with the conversational voice.

3. The use of the amplified voice, directed at will to one ear or the other, in testing for malingering.

4. A device for quantitative tests of bone-conduction.

5. The use of convenient form of noise apparatus.

6. A double use of the same audion bulbs, whereby these bulbs could be used either as an amplifier or as an oscillator.

7. If possible, the uniting of all these features in one instrument.

At first, tests were made for the conversational voice and the whisper, with a simple vacuum-tube amplifier. Two old ladies, about equally deaf, were the first ones tested. It was found that one of them heard perfectly the ordinary conversational speech and even the whisper, with the use of the amplifier. The other one not only did not hear better with the instrument, but heard better without the amplification. Careful functional tests, auditory and vestibular, showed that the first one had good internal ear function; the second one, impaired internal ear function. A series of patients was then tested. In these patients the nature of the hearing impairment was carefully studied by the usual functional tests. It seemed that the following tentative conclusions could be drawn: Those with conductive lesions can hear very well with the use of the amplifier; those with perceptive lesions can not hear so well, and in many instances are much annoyed by the use of the amplifier.

On carrying further the studies with the amplifier, we then thought it would be desirable to provide a selective amplification, in testing with the conversational voice. Ordinary speech includes vibrations ranging between 100 and 5,000 d. v. It seemed that such selective amplification of the human voice would provide another simple method for making a further discrimination between conductive and perceptive deafness. By such selective amplification,

one could emphasize the low tones of the human voice, or on the other hand, emphasize the high tones of the human voice.

A hope also arose that, following this same idea in an instrument for testing the hearing, there could be made an instrument for correcting the hearing, with selective amplification. Such an instrument would, as it were, constitute "spectacles for the deaf". We are all familiar with the dissatisfaction expressed by patients with the available commercial types of artificial aids to hearing. It seemed reasonable to consider that the disagreeable features might be due in part to amplification of certain tones that need no amplification.

In an attempt to incorporate the above features in a single unit, the writers have designed an instrument which they have named the "Audio-Amplifier". We wish particularly to emphasize that we do not regard it as necessarily a "new" instrument. The amplifier portion of the instrument is similar to amplifiers used in common radio and long-distance telephone practice. The bone-conduction device may be available in other instruments, although we have found no published records of such a device. Similarly, the noise apparatus may be available in other instruments of which we do not know. The audiometer portion of the instrument follows the method introduced by the Western Electric Company. For the past few years so much work has been done that it is impossible to know what should be regarded as strictly "new". This "Audio-Amplifier", therefore, is presented simply as our best conception of a useful instrument for daily routine office work.

In presenting this instrument for your consideration, Prof. Knudsen and I will be very appreciative of criticisms. Personally, I want to take this opportunity of expressing appreciation to Prof. Knudsen for the many months of work that he has devoted to this subject. So far as I personally am concerned, the instrument that he has made meets practically every need that I can think of in daily routine practice. I rather expect the principal routine use of this instrument in my hands will be the amplifier portion: simply putting the receivers to the ears of the patient, carrying on a short conversation, determining whether it is conductive or perceptive deafness, and making a rough quantitive measurement of the percentage of hearing defect in each ear. Not only is it helpful to be able to do this in a minute or two, but we find that the patient responds with more interest to conversation than to the mere production of certain tones. On the other hand, it is helpful to have, in the audiometer portion, not only the means of making a quick test of low,

medium and high tones, but an instrument that is capable of making very precise and exhaustive tests in selected cases.

FROM THE STANDPOINT OF PHYSICS.

In approaching this subject from the point of view of a physicist, it is desirable to consider the mechanical and acoustical characteristics of various types of hearing impairments. A thorough understanding of these characteristics will enable us to devise and conduct functional tests of hearing more effectively. Thus, if the acoustical characteristics of different types of deafness are known, then measurements of the auditory acuity for tones of different pitch and measurements of the sound conductivity to the cochlea by air, bone and cartilage paths, will give data that will enable us to make a different diagnosis between different types of deafness. These measurements will also indicate the degree of the hearing defect and further will enable us to determine the requirements of an artificial aid to hearing to correct a given defect, provided, of course, that the auditory nerve is normal or nearly normal.

The otologist ordinarily classifies hearing impairments as conductive or perceptive. For the present purpose it will be helpful to subdivide conductive impairment into two types: obstructive and fixation. From the point of view of the physics of deafness, therefore, hearing impairments can be classified as follows:

1. Conductive impairments. *a* obstruction in external auditory canal; *b* fixation in middle ear.
2. Perceptive impairments.

It has seemed advisable to the writers to consider "fixation" as including all lesions of the drum membrane, the middle ear cavity or the ossicular chain. Such lesions produce a more or less complete fixation of the conductive mechanism of the middle ear.

It is a simple problem to pre-determine the acoustical characteristics of obstructive or fixational impairments. An obstruction in the external auditory canal closes the "door" to the middle and internal ears. This is analogous to closing the door to the music room. Experience, supported by physical measurements, demonstrates that shutting the door to the music room will diminish, nearly equally, tones of all pitch which enter an adjacent room. One would predict therefore that obstructive deafness should be characterized acoustically by a uniform diminution of the hearing acuity for tones of low, medium or high pitch. This is confirmed by observaton and precise measurements.

The acoustical characteristics of fixation impairments are not so simply explained as those for obstructive impairments. In order

to appreciate the physical characteristics of an impairment of fixation it will be necessary to keep in mind two factors. First, tones of low pitch must possess much more sound energy than tones of high pitch to elicit sensations of equal loudness. Thus a tone of 64 double vibrations per second must possess 10,000 times as much energy as a tone of 1,024 double vibrations per second if the two are to produce equal loudness sensations in a normal ear. Second, tones of low pitch must have much greater amplitudes of vibration than tones of high pitch if the two are to possess equal amounts of sound energy. Thus, a tone of 64 double vibrations per second must have an amplitude 256 times as great as a tone of 1,024 double vibrations per second for the two tones to possess equal amounts of sound energy. Both of these factors conspire to require relatively gross movements of the conductive mechanism of the middle ear for tones of low pitch and only infinitesimal movements for tones of high pitch. Thus, if the two tones considered above are to produce equal loudness sensations, the 64 d. v. tone will require displacements of the stapes 25,600 times greater than those for the 1,024 d. v. tone. One would predict, therefore, that fixation deafness should be characterized acoustically by a great diminution of the hearing acuity for tones of low pitch and by only a very slight diminution for the tones of high pitch. This is confirmed by observation and precise measurements.

Perceptive impairments, of the most common type, result from changes within the cochlea or eighth nerve. On the basis of any resonance theory of audition, and it seems to the writer that a resonance theory is the only tenable one, those portions of the tectorial or basilar membrane which respond to tones of high pitch will be the most delicate parts of the vibrating structure and will also be subject to greater tension than those portions which respond to tones of low pitch. It is reasonable to expect, therefore, that pathologic changes within the cochlea should produce greater destruction among the delicate and tightly stretched portions of the vibrating structure than among the relatively gross and slightly stretched portions. Hence, one would predict that perceptive deafness, of the type here described, should be characterized acoustically by a great diminution of the hearing acuity for tones of high pitch and by a lesser diminution for the tones of low pitch. This prediction is also confirmed by observation and precise measurements.

From the above physical considerations there are three outstanding types of deafness, each of which possesses definite and distinct acoustical characteristics. To summarize, obstructional deafness is characterized by a diminution of the hearing acuity for tones of

all pitch, fixational deafness is characterized by a great diminution for tones of low pitch and only a slight diminution for tones of high pitch, and perceptional deafness is characterized by a very great diminution for tones of high pitch and a lesser diminution for tones of low pitch.

Conductive impairments produce partial deafness because insufficient sound energy reaches the cochlea. Perceptive impairments produce partial or total deafness because the sensitiveness of the receptive apparatus within the cochlea has been dulled. Appropriate amplification of speech or music will restore hearing for those who have conductive impairments, whereas, the amplification of speech or music in general only overload the already weakened receptive apparatus of the cochlea for those who have advanced perceptive impairments. For those who have only a slight perceptive impairment it is probable that appropriate amplification may improve normal hearing.

The acoustical characteristics of the three types of deafness just considered suggested the use of a selective amplifier for two purposes: 1, for making a differential diagnosis between obstructive, fixation and perceptive impairments; 2, for correcting hearing impairments.

The selective amplifier for testing purposes should be designed to give three types of selective amplification: 1, uniform amplification of all the frequency components of the whispered and conversational voice; 2, large amplification of the low frequency components of the whispered and conversational voice with only slight amplification of the high frequency components; 3, large amplification of the high frequency components of the whispered and conversational voice with a lesser amplification of the low frequency components. These are the types of amplification required to correct obstructive, fixation and, in some instances, perceptive impairments, respectively.

For convenience of notation and description these three types of amplification will be called, 1, "uniform amplification", meaning that tones of all pitch are amplified equally; 2, "low pass amplification", meaning that tones of low pitch are given full amplification and as we go up the scale of pitch the amplification becomes increasingly less and less, and, 3, "high pass amplification", meaning that the tones of high pitch are given a large amplification and as we go down the scale of pitch the amplification becomes increasingly less and less. These three types of amplification can be attained in electrical circuits by introducing suitable combinations of inductances, resistances and capacitances.

The writers have constructed an amplifier which embodies the above features of selective amplification. This amplifier constitutes an essential and useful part of the instrument described in this paper, the Audio-Amplifier. Its uses will be discussed under the section on the technique of examing a patient.

TECHNICAL DESCRIPTION OF THE AUDIO-AMPLIFIER.

Figure 1 shows the general arrangement of apparatus and the wiring diagram of the Audio-Amplifier. The diagram shows the four principal features of the instrument: a speech amplifier, an audiometer, a special receiver for measuring bone conduction, and a noise apparatus.

When the key K_1 is closed in one direction the instrument is a speech amplifier. The speech amplifier is similar to amplifiers employed in telephone and radio practice. The speech enters a transmitter (T) and is then amplified by the two stage vacuum tube amplifier. In the output of the amplifier, between the second tube and the telephone receiver, is a volume control. This consists of a combination of series and parallel resistances. By means of a dial associated with the volume control the volume of the speech in the receiver can be regulated to give all gradations of loudness from inaudibility to speech of great loudness.

Between the two stages of the amplifier is a correction circuit. This consists of an inductance L, a resistance R, and a capacitance C. These are arranged so that when the key K_2 is in its neutral position the correction circuit is not connected in the amplifier circuit and

therefore tones of all pitch are amplified equally.[1] When the key K_2 is closed in one direction the capacitance C and the resistance R are connected across the input of the second tube. This provides "low pass amplification", that is, the tones of low pitch pass at full amplification and the tones of high pitch pass with only slight amplification. In contrast, when the key K_2 is closed in the opposite direction, the inductance L and the capacitance C are connected across the input of the second tube. This provides "high pass amplification", that is, the tones of high pitch pass at full amplification and the tones of low pitch pass with a lesser amplification.

By closing the key K_1 in the opposite direction the instrument is converted from a speech amplifier to an audiometer. The audiometer portion of the audio-amplifier does not differ essentially from the Western Electric Company's audiometer. In the description of the speech-amplifier we noted that the amplification was produced by two audion tubes. When the instrument is changed into an audiometer the same two vacuum tubes which were employed for the speech-amplifier are utilized for the audiometer. The first tube, with its associated resonant circuit, becomes an oscillator. The second tube continues to function as an amplifier. By these means it is possible to produce tones of low, medium, or high pitch and of any loudness from the minimal threshold to tones which are very loud. The loudness of the tones is controlled by the same volume control which was used to control the loudness of speech in the amplifier described above.

The instrument which we have been using for testing patients during the past eight months will produce tones of the following frequencies: 64 d. v., 128 d. v., 256 d. v., 512 d. v., 1024 d. v., 2,048 d. v., 4,096 d. v., 8,192 d. v., and tones of every gradation of pitch above 7,000 d. v., up to and beyond the upper limit of audibility. There is also a fine adjustment for the pitch control which provides a means for producing small differences of pitch. This is useful in testing for diplacusis and sensibility to small differences of pitch.

Attention is called to the question of the upper limit of audibility. The upper limit for the average person is between 18,000 and 20,000 d. v., and not 30,000 or more as is frequently recorded in the text books, and commonly understood among otologists who use the Galton Whistle. This upper limit of audibility, viz., 18,000 to 20,000 d. v., has been very definitely established by the investigations of a

[1]This is true only for a "high quality" speech amplifier which employs a transmitter and a receiver whose diaphrams have high natural frequencies and are highly damped. It is only approximately true for speech amplifiers which employ the usual commercial transmitters and receivers.

number of physicists who have made accurate measurements with tones produced by the vacuum tube oscillator. The work of Wegel of the Western Electric Company gives very conclusive evidence that the upper limit of audibility does exceed about 20,000 d. v.

The special telephone receiver for the quantitive measuring of bone conduction is a modified form of a commercial telephone receiver. The ordinary circular diaphram of the receiver is replaced by a narrow strip of magnetic steel. This reduces to a very slight amount the sound energy radiated to the air. Attached to the center of this strip is an aluminum rod 7 inches long. The rod and strip diaphram combined are designed to have a natural frequency of about 256 d. v. Hence the diaphram will respond more vigorously when excited with a frequency of 256 d. v. than it will for any other frequency of excitation. The bone conduction measurements are then made at this frequency, although it is possible to make measurements, using the same receiver, at frequencies of 128 d. v. and 512 d. v. Measurements of bone conduction are made by pressing gently but firmly the distal end of the rod against the mastoid bone. The sound waves are then communicated to and conducted along the aluminum rod, thence to the mastoid bone and thence to the internal ear. The loudness of the tone can be reduced to the minimal threshold by employing the volume control already described.

The noise apparatus consists of an ordinary electric buzzer and a telephone receiver connected across the contact points of the buzzer. This produces an interrupted induced current in the coils of the telephone receiver which gives rise to a loud noise in the receiver. In this way there is available a source of noise to produce a masking effect in an ear which has hearing function while the other ear is tested.

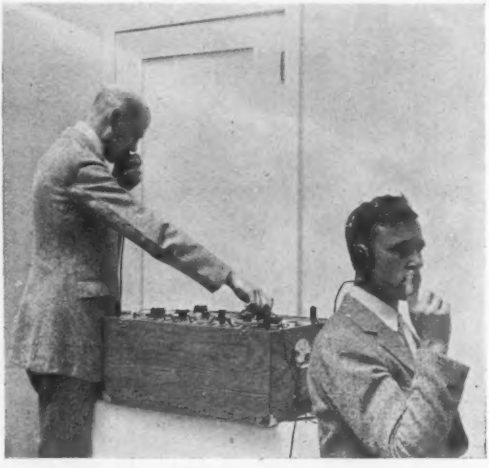
TECHNIC OF EXAMINING A PATIENT WITH THE AUDIO-AMPLIFIER.

The procedure the writers have been using in testing a patient with the audio-amplifier is as follows:

In addition to obtaining the usual history of the case, the patient is asked the following questions. How old when impairment of hearing developed? Do you hear better in a moving train, an automobile or in the presence of a noise than in a quiet room? How do you hear over the telephone? Over the radio when listening with a head set? Have you any noises in the head?

The patient is first tested with the amplified conversational voice. A radio head set is adjusted to the patient's head so that a receiver is held to each ear. By means of the key K_e the speech is directed to either ear. The examiner then speaks a few words into the

transmitter, in a low tone of voice and with the patient so placed that he cannot see the examiner; first with "uniform amplification", then with "low pass amplification" and then with "high pass amplification". The patient is then asked what kind of amplification produces the best and most natural quality of speech. The loudness is then adjusted by means of the volume control until the speech is heard best by the patient. If the patient has obstructive deafness he will hear best with uniform amplification, if he has fixation deafness he will hear best with low pass amplification, if he has nerve deafness, which has not progressed too far, he probably will hear best with high pass amplification. If the nerve deafness is pronounced the speech will be confused and will sound un-



pleasant to the patient no matter what kind of amplification is produced.

Having found the kind of amplification best suited to the patient, the examiner uses the whispered voice and reduces the loudness until the patient can no longer make out what the examiner is saying. The position of the dial associated with the volume control is noted, and by comparing this with a chart of calibrations the percentage of deafness is read off directly. In many instances no further tests will be necessary. The nature and approximately the percentage of the hearing defect have been determined, and the test has required only a few minutes or two for its completion.

In many instances, however, it is desirable to obtain more confirmatory, precise and complete measurements. These include quan-

titative measurements of bone conduction and precise measurements with the audiometer. Bone conduction measurements are made with a tone of 256 d. v., and, if desired, with tones of 128 d. v. and 512 d. v. The distal end of the aluminum rod is pressed firmly but gently against the mastoid bone. The weight of the receiver will supply a convenient, and will secure a uniform pressure. The loudness of the tone is then reduced to the point of minimal audibility, the reading of the dial is noted, and compared with the normal given on a calibration sheet. This gives a quantitative measurement of the bone conduction and it can be compared also with the air conduction. The latter is obtained in the usual manner with the audiometer portion of the instrument.

The Weber test is then made by pressing the base of the casing of the bone conduction receiver against the top of the head in the medial plane. The testing tone can be maintained at a uniform loudness and does not die away as does the tone from a tuning fork. This is desirable and convenient for the Weber test.

The patient is then subjected to the usual audiometric measurements. Ordinarily it is sufficient to test him with a low, a medium and a high tone. Tones of 64 d. v., 256 d. v., 1,024 d. v. and 4,096 d. v. are the ones ordinarily employed. The point of minimal audibility is noted at each of these tones and, by comparing these with a calibration sheet, the percentage deafness for each tone may be read off directly. The upper limits of audibility are then determined for each ear by turning a dial until the point of disappearance is located. The reading of the dial is noted and, by comparison with

the calibration sheet, the upper limits are expressed in double vibrations per second. In certain selected cases audiometric measurements are made at shorter pitch intervals.

If the patient complains of a confusion of sounds it is advisable to test for diplacusis. This is done by directing the same tone from one ear to the other and asking the patient if the tone has the same pitch as heard by each ear. If the two ears of the patient differ greatly in their auditory acuity for the test tone, the examiner should adjust the loudness of the tones so that they are heard equally loud with either ear. This adjustment must be made quickly, during the interval that the tone is transferred from one ear to the other. These tests should be made for low, medium and high tones. If diplacusis is present the amount of the pitch displacement can be measured by altering the pitch of the two tones presented to the two ears until the patient judges them to be of the same pitch.

If tinnitus is present and has a characteristic pitch it is of interest, and in some instances of considerable value, to determine the pitch and loudness of the subjective tone. This is done by producing an objective tone which the patient judges to be of the same pitch and loudness as the subjective tone.

If, for any reason, the patient is to be tested for malingering in cases of reported unilateral deafness, the amplified conversational voice can be directed to either ear at will. The patient turns his back to the operator with a receiver to each ear. The operator converses with him, directing the conversation to one ear and then the other. If the patient's attention can be directed to some subject in which he is interested, the nature of his answers to the operator's questions may yield a conclusive answer to the question of malingering. Dr. Eugene R. Lewis has suggested the use of certain sentences in testing for malingering. These sentences are so constructed that they will give one meaning when all the words are used, a second meaning when only selected words are used, and a third meaning when the remaining words are used. For example, consider the following sentence: "Next Thursday, (at seven o'clock), I shall see you (at the theater)." The operator speaks these words to the patient, directing the words which are not in parentheses into one ear, and the words which are in parentheses into the other ear. The patient is requested to repeat or write down what he hears. His answer may give conclusive evidence of malingering.

The result of an examination with the audio-amplifier should be recorded on an auditory chart. The writers are working out a chart which they hope will be suitable for this purpose. The follow-

ing general outline suggests the type of chart the writers are using at present.

I. Questions about the onset, symptoms, etc.

RIGHT EAR	LEFT EAR
II. Measurements with the amplifier.	
Heard best with.....	Heard best with.....
Disappears at.....	Disappears at.....
.:. % deafness.....	.:. % deafness.....
III. Bone Conduction Measurements.	
Minimal threshold.....	Minimal threshold.....
Weber referred to.....	
IV. Audiometric measurements—Percentage deafness.	
64..... 128..... 256..... 512.....	
1024..... 2048..... 4096..... 8192..... Same for left.	
Upper limit.....	Upper limit.....
V. Diplacusis	
VI. Tinnitus	

It is the belief of the writers' that the audio-amplifier, and other instruments for measuring the auditory acuity, will serve their greatest usefulness in discriminating between correctable and incorrectable types of deafness, and in prescribing artificial aids to hearing which are designed to correct the particular defects of each individual case. The selective amplifier portion of the audio-amplifier is particularly useful for this purpose, because the patient at once realizes at the time of examination what help he can derive from a uniform, a low pass or a high pass amplification. The writers have been working on the designs of portable selective amplifiers for correcting hearing defects. These amplifiers are constructed according to the prescription given by measurements of the auditory acuity. Three such amplifiers, or "magnaphones", have been constructed for three different ladies, and have given good results. These "magnaphones" are made up of a transmitter, a two-stage amplifier, a correction circuit and a telephone receiver. They are encased in leather vanity cases, seven inches long, six inches high and three and a half inches in thickness.

There is a single difficulty in the way of making these "selective amplifiers" entirely satisfactory: the absence of an efficient, high quality transmitter. This difficulty is also present in all of the various commercial electrical aids to hearing.

If such an efficient, high quality transmitter can be developed, and there is good reason to anticipate this development, we shall be able to place the prescribing of artificial aids to hearing upon the same scientific basis as the grinding of lenses for the correction of defects of vision. This would constitute the greatest possible reward for the efforts of the many otologists and physicists who have worked in this field.

THE MASKING OF SOUND; ITS BEARING UPON THE FUNCTIONAL TESTS AND THE PHYSIOLOGY OF HEARING.*

DR. EDMUND PRINCE FOWLER, New York City.

Through the kind invitation of your Chairman, I am privileged to present some recent work upon the dynamics of the ear, particularly that of Wegel and Lane on the auditory masking of pure tones.[1] The ability of the human ear to hear clearly desired sounds in the presence of other fairly loud sounds is well known. Likewise, its inability to sense certain sounds when very loud sounds are reaching it, but heretofore no accurate data has been obtained upon which to found a reliable explanation of the phenomena, because no machine existed with which it was possible to measure accurately acoustic phenomena. Now, however, the vacuum tube, the thermal receiver, and the condenser-transmitter have been sufficiently perfected to aid us. Moreover, a few physicists are interested in evolving a workable theory of audition based upon the dynamics of the ear, in connection with certain problems in telephony, wireless, etc. It is through my association with some of these men that I have become more or less familiar with the subject, and I trust competent to transmit the essence of their work to others.

We will consider first the phenomena of masking, and then its application in otologic practice and the hearing of the data upon the theory of tone discrimination in the cochlea. Masking, or the obscuring of one sound by another, denotes the inability of the ear to sense certain sounds in the presence of certain other sounds. The study of masking is interesting in itself, for its bearing upon tests for hearing and diagnosis, and especially because it gives us a new set of measurements applicable to the acoustic reactions of the auditory mechanism. Fig. 1 is self-explanatory. It represents graphically the total auditory capacity of the human ear, in frequency and intensity range. (Ordinates measure intensities, abscissae measure frequencies.) The important region is that most used for speech (i. e., 400 to 4000 cycles).[2]

The lower curve shows the minimum amount of sound pressure audible at each frequency. Note that in the range most used for speech this pressure is 1/1000 dyne, equivalent to 1/1,000,000,000

*Read before the Section on Otology, New York Academy of Medicine, Apr. 11, 1924.

Editor's Note—This mss. received in The Laryngoscope Office and accepted for publication June 2, 1924.

change in atmospheric pressure at sea level. The upper curve shows the maximum amount of sound pressure audible at each frequency, without feeling or pain entering largely into the sensation.

Fig. 2 shows the masking of various frequencies by a masking tone of 1200 cycles (1200 d. v.). The curves of masking are obtained by plotting logarithmically as ordinates, the loudness necessary at various frequencies for minimum audibility in the presence of another tone (the masking tone). The frequency of the masking tone is given at the top of the illustration (1200 cycles, i. e., 1200 double vibrations). Its loudness is plotted as abscissae. The frequency of the tone being masked is just above each curve; the tones were introduced into the same ear; the apparatus used was two electro-audiometers, both connected to a specially constructed single air-damped receiver for the ear tested. The pressure of sound necessary for minimum audibility was taken as a unit of measure at each frequency.

For example: Curve I shows that a masking tone of 1200 cycles plotted in relation to the magnitude of a 350 cycle tone, causes practically no masking, though it be increased in volume to 10,000 times the value of its minimum audible pressure, i. e., 10,000 times the pressure of sound necessary for its detection as a sound in the normal ear (minimum audible value is marked 1).

It means that the 350 cycle tone, even at its minimum audible intensity is not masked by the very loud 1200 cycle masking tone.

Curves 2 to 15 show that as the masking frequency is approached by the masked tone, the masking effect of the 1200 cycle tone increases, so that in order to be heard, the tone being masked must be increased more and more (especially at the greater intensities), until when the masked and masking tones are near together the curves become almost a straight line at 45,° and cutting the abscissae lines at 10 times the minimum audible pressure of the masking tone. In other words, loud tones near in frequency are more easily masked; the masking tone needed being but 10 times that of the masked tone to mask the latter.

One hundred and thirty-five curves were plotted in a similar manner to those in Fig. 2, for masking tones of 200, 300, 400, 600, 800, 1200, 1800, 2400 and 3500 cycles, with masked tones from 150 to 2500 cycles. Variations between different normal observers were small. All these curves present certain general characteristics of masking in relation to intensity and frequency:

1. Tones much below the frequency of the masking tone are not perceptibly masked by the smaller intensities, and are only slightly masked for the very loud tones.

2. Tones much above the frequency of the masking tone also are not perceptibly masked by the smaller intensities, but at a definite high intensity masking occurs and quickly increases as the masking tone is increased.

3. Masking is greatest when the tones are close together.

4. When so close together as to produce beats, the curves really represent measurements of the minimum perceptible intensity fluctuations of the beating tone. This accounts for the depression in such curves at low intensities, as here the two tones may be separately inaudible and yet if they are not below one-half the minimum audible pressure, beats will appear as the tones alternately coincide and diverge in phase. At higher intensities, the amount of

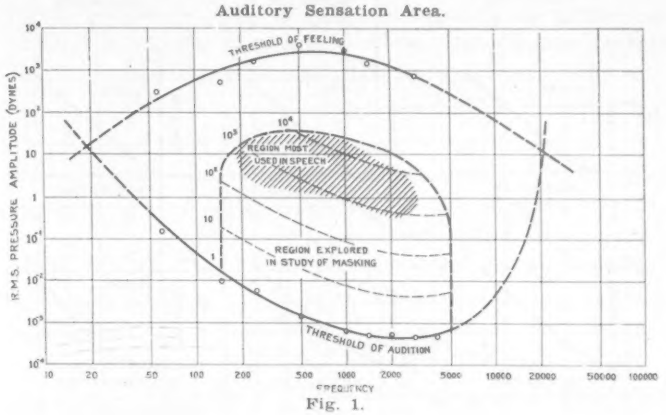


Fig. 1.

the minimum perceptible beating fluctuation may be obtained from the difference between abscissae and ordinates.

Fig. 3 shows the effect of masking binaurally, i. e., the masking tone is introduced into one ear and the tone to be masked in the opposite ear. The broken line curves represent monaural masking, as in Fig. 2. The two curves are very similar except for the displacement of the binaural curves to the right, this displacement representing about 10,000 times the intensity of the monaural curves. (It means that to mask at even its minimum audible intensity, a tone in the opposite ear, a tone often must be increased in intensity 10,000 times its threshold value.) It suggests that the masking in the monaural is "peripheral" (i. e., in the ear), and in the binaural, "central" (i. e., in the brain, due to conflict or unreliability of sensations).

Data for Masking Tone of 1,200 Cycles.

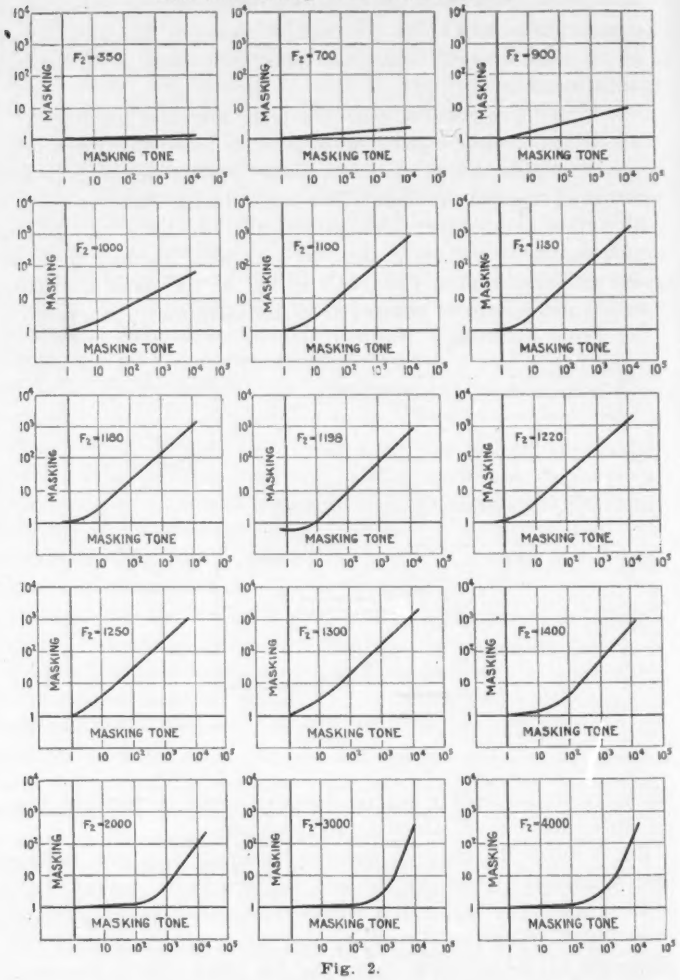


Fig. 2.

This central masking must be very small, because at large intensities the sound would be brought to the opposite ear by air and bone conduction. The similarity of both curves makes this latter appear probable. Hence, this demonstrates, as do also tests upon persons with one ear totally deaf, that there is a diminution of the sound from a telephone receiver in going through or around

the head in the ratio of about 500 to 1, depending somewhat on frequency. In unconfined sounds, like those from tuning forks, a smaller figure would hold.

If two tuning forks arranged to produce beats are held vibrating equally, one before each ear, the beats will cease to be heard 5 to 10 seconds (depending upon the fork) before the ear fails to hear the tones; but if held one on each mastoid process, the beats will cease coincidently with the cessation of the tones. This further confirms our opinion that the tests are set up in the peripheral apparatus of hearing, and that they are not simply brain interpretations; because in the above latter case each ear is affected by the fork in the opposite ear, by bone conduction; and the loss in intensity by bone conduction through the head is slight. Whereas by air conduction, though each ear hears its own fork vibrate, when the intensity falls

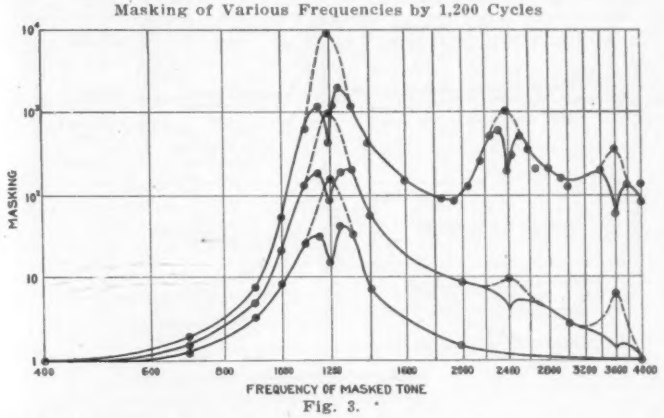


Fig. 3.

below minimum audibility for air conduction to the opposite ear, the beats cease, as the tones then are not carried to the opposite ears. If masking were central, it would appear that the beats should continue to be heard as long as each ear heard its fork sound. As stated, the beats do not thus continue.

Fig. 4 shows the masking effect upon various frequencies of a tone of 1200 cycles at three different degrees of loudness (160, 1000 and 10,000 times its minimum audible intensity). Disregarding the region of beats, the lowest curve shows a gradual falling off of the masking effect as the masked frequencies lie further and further to either side of the masking tone. The highest curve shows that in the region of the first and second overtones of the masking frequency, similar characteristics are found to those near the funda-

mental masking frequency. In other words, these are like replicas of the lower curve, as if three masking frequencies, 1200, 2400, 3600 cycles, were present at the same time, with relative intensities of 1.00, 0.10, 0.025 (1, 1-10, 1-40).

But an harmonic analysis of the masking sound in the air did not show these two overtones present; hence they were actually set up in the ear, due to some reaction therein. The magnitudes of these overtones were obtained experimentally. The middle curve represents a transition between the upper and the lower curves, and indicates overtones with relative intensities of 1.00, 0.01, 0.006 (1, 1-10, 1-170). All these curves show how a tone masks frequencies higher than itself better than lower frequencies only when it is loud. In the abnormal ear, this relationship may be somewhat different.

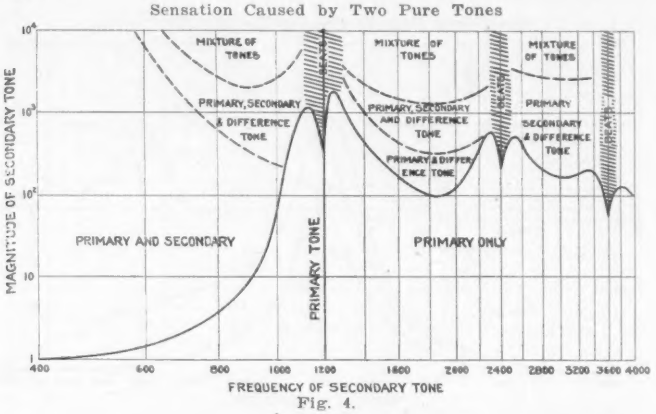


Fig. 4.

Fig. 5 shows in the unbroken line the same curve as the topmost one in Fig. 4 at an intensity of 10^4 (10,000 times min. aud.) in combination with various secondarily introduced frequencies (represented by the abscissae and their magnitudes by the ordinates). In addition to the masking data, it was observed that the character of the sensations experienced varied greatly when the masked tone became audible.

For example, introduce a secondary tone of say 800 cycles in the presence of the constant 1200 cycle tone. As this 800 tone is increased in intensity from below audibility to audibility in the presence of the masking tone, it is perceived as a separate tone simultaneously with the primary tone of 1200 cycles, and it may be still so heard until its intensity is increased to a value indicated

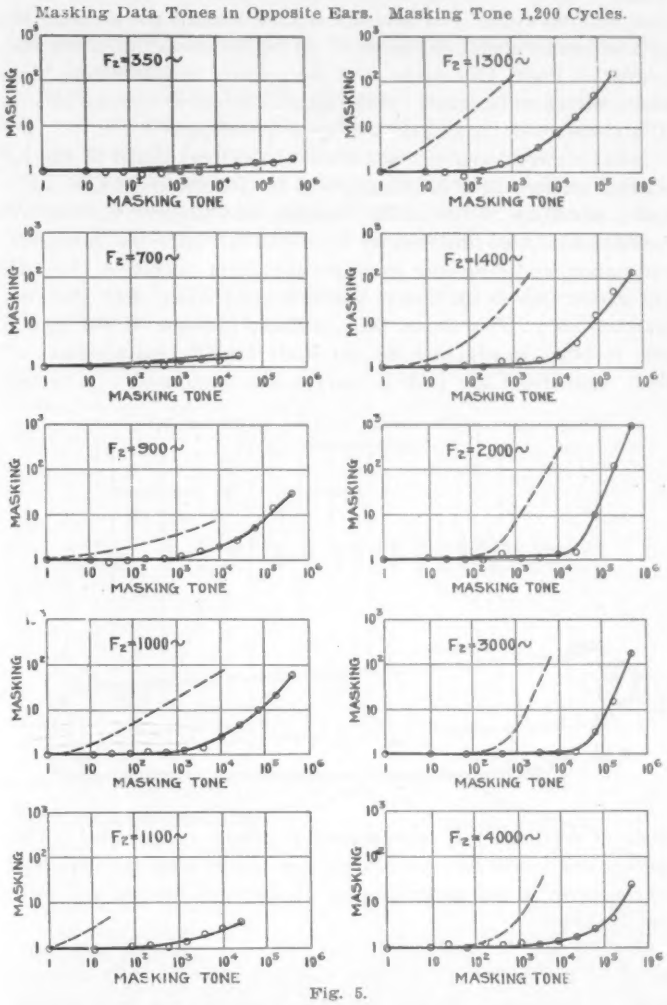


Fig. 5.

by the lower broken line. Then the difference tone (400 cycles) is also distinguishable, and increasingly so until at the higher intensities above the upper broken line, a very complex mixture of tones is heard.

Again, introduce a secondary tone of between 1600 and 2000, say, 1900 cycles, in the same way simultaneously with the primary

tone of 1200 cycles. Its presence is first detected not as such, but as a difference tone (700 cycles). At higher intensities, it becomes audible as itself, 1900 cycles, but the primary and difference tones also continue to be heard. Still higher, a mixture of tones obtains. The meaning of the rest of the figure is obvious.

Now, a careful analysis was made of the tones heard by the ear when a primary 1200 at intensity 6 x 10^4 (60,000 times min. aud.) and a secondary of 700 of like intensity was present, and the frequencies found in this mixture were (all but one) the harmonics, summation, and difference tones possible from combining 1200 and 700 cycles (up to the fourth order, beyond which they were not searched for). This shows the non-linear response of the normal ear; in other words, that the ear itself actually manufactures all these tones from the pure primary tones introduced. In certain

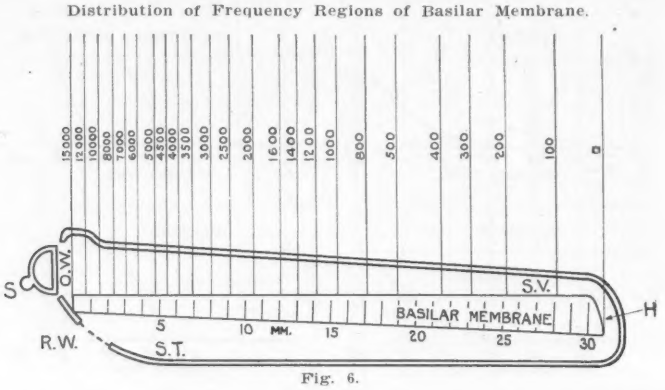


Fig. 6.

kinds of deafness, this non-linearity is greatly exaggerated. This opens a virgin field for research which promises some day important developments in our understanding of abnormal hearing and cochlear dynamics.

Masking may be produced by the masked or masking tone introduced by air conduction, by bone conduction, or by both methods, singly or combined. As yet, the data—especially for bone conduction masking—is not ready for definite statement. A few outstanding points follow:

(Using 2 noise apparatus for masking, 1 in each ear.)

1. *In normal ears* it is easy to mask even very loud sounds by air conduction, if careful technique is used.

2. It is impossible to mask all sounds, as it is simply a matter

of loudness, and if the intensity to be masked is sufficient the sound will not be masked.

3. Bone conduction by the Hartmann tuning forks may be totally masked. Lower Edelman forks, giving great intensities, and low forks generally by bone conduction are marked with difficulty. There is practically no crossed masking for bone conduction forks while using an air conducted masking tone; and for air conduction only if the masking tones are over 500 times louder than the masked tones.

1. *In abnormal ears,* nerve deafness cases may be masked easily or not, depending upon the lesions.

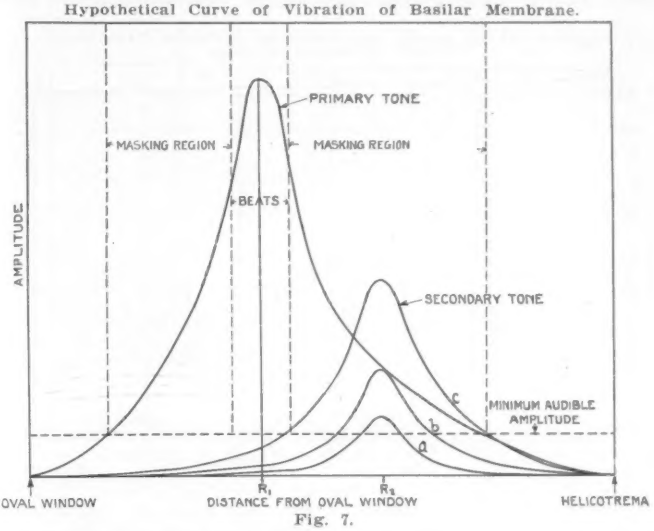


Fig. 7.

2. Conduction deafness cases are easily masked if the deafness is of small degree, but the masking becomes more and more difficult with increasing deafness, because the sound to be masked must—to be heard at all—be so loud that it is difficult to introduce a masking sound so much louder as to effectively obscure it. Relatively, masked and masking sounds are heard in like ratio to one another as in the normal.

3. It is impossible to totally mask low bone conduction forks by the noise apparatus in conduction deafness, because the lesions carry in the fork vibrations at high intensity, and the air vibrations cannot readily pass. (The noise apparatus is heard mainly by air conduction.)

In some very deaf conductive deafness ears, a tone from a vertex fork will be heard in the air-masked ear, probably because of the receiver's added resonance or the increased bone conduction in that ear, and because the masking tone is not loud enough to appreciably affect even minimum audibility in these cases (other reasons also may be thought of).

The important thing to remember in masking one ear for the purpose of testing exclusively the opposite ear, is to always first test the efficiency of the masking apparatus by employing two instruments—one to each ear simultaneously—then, if the patient hears nothing, remove the one upon the ear to be tested, and retest. Check up the results several times if the patient appears to have

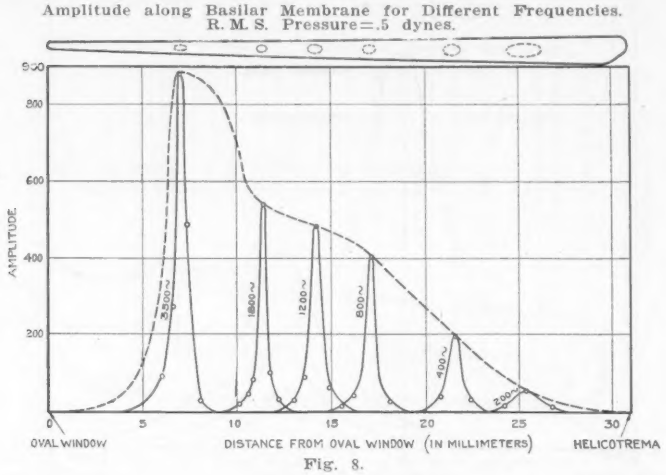


Fig. 8.

any hearing in the tested ear. I have examined case after case declared to have some hearing, only to find that the ear was stone deaf to the loudest sounds I could bring to bear upon it, demonstrating that a too sanguine reliance upon the efficacy of a noise apparatus may prove misleading.

Many of the noise apparatus sold are deficient in loudness and in frequency range. The ideal apparatus would be one confining its noise to the ear being masked and whose bone conduction was practically nil.

Before leaving the subject of masking, let us consider the effect upon the deaf of extraneous noises. Many such persons cannot hear in noisy places, or if several people are speaking at the same

time. These are thought to be more often the nerve deaf. Why? Because the lesions may cut down markedly speech frequency sensitivity and yet permit other frequencies to be well heard, and hence the noises easily mask the faint intensities of speech, reaching their ears. Relatively, the lesser of two simultaneous sounds appears to a deaf person much fainter than to the normal ear. For the low intensities, one-seventh, or 15 per cent change of sound pressure is required before any loudness variation is noted; and for higher intensities the normal ear requires one-twentieth or 5 per cent change in sound pressure, to sense any change in loudness. To a very deaf ear, all intensities appear weak, hence no increase is

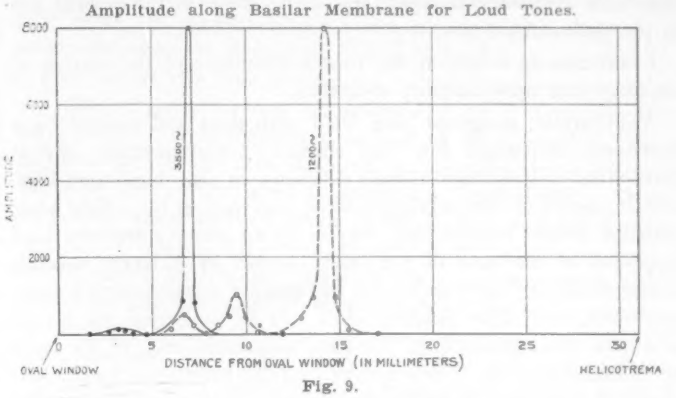


Fig. 9.

noted though speech be considerably louder. Moreover, if a speaker's voice is unduly loud, its sound intensity is too great for good audition.

Other persons claim that they hear better in a noise. These are said to be often the conduction deafness cases. Why? Because, first, the inner ear is intact and everyone tends to speak louder in the presence of a disturbing noise so that his voice will prevail above this noise; hence the speech reaches the cochlea in adequate volume; and, second, the noise intensity reaching the deaf ear will be less increased, proportionately, than the intensity increase of the nearby speech; third, extensive vibrations of relaxed middle ear structures may so alter their tension as to better transmit the speech frequencies. It may be proved experimentally that there is usually no real increase in speech perception in a noisy place, by having a very deaf person speak to the one tested; first, in a quiet and then in a noisy surrounding. Very deaf persons do not

raise their voices in ordinary noise, not hearing it. Space forbids further discussion along these lines at this time.

The phenomena of masking has been considered fatal to the Helmholtz or any resonator theory of tone discrimination. It has now, however, actually furnished data which makes it possible to calculate certain vibration characteristics of the inner ear and to reaffirm a belief in at least a modified resonance theory. Necessarily the smallness and inaccessibility of the auditory labyrinth makes any but an indirect method of attack impossible. Masking data furnish one weapon for such an attack. Another is the minimum audibility at different frequencies; and a third, the minimum detectable frequency changes; and all of these in the normal and in the abnormal ear.

I will take up briefly at this time a discussion of the bearing of masking data upon auditory dynamics.

Any narrow, elongated tube filled with fluid and divided by a horizontal diaphragm into two channels communicating only at their distal end, through a small deficiency of said diaphragm here, and stoppered at the proximal end of one channel by a rigid plate fastened around its periphery thereto by an elastic membrane, and stoppered at the base of the other channel by a freely movable round membrane—any such tube will possess certain acoustic characteristics, and these characteristics will be analogous no matter what the exact dimensions, densities, elasticities, etc., of its walls or contents may be. Such a tube, spirally coiled two and a half times, 32 m.m. long, is the human cochlea. Such a cochlea uncoiled and reduced to its simplest elements is represented by Fig. 6.

Sound pressure vibrations moving the stapes (S) as a treadle or piston, in and out of the oval window, will cause a mass movement of the fluid in the scala vestibuli, which mass movement can occur only by a displacement of the basilar membrane or through the helicotrema (H), or both, and in addition, by an outward and inward excursion of the round window membrane (R.W.). The latter, necessarily moving in opposite phase to that of the stapes movement, that is, while the stapes goes in, the R.W. membrane goes out, and vice versa. If the round window membrane is immobile, no measureable mass movement of the contents of the cochlea can take place. Sound wave propagation is by mass movement; it cannot be originated or propagated without to and from mass movements. If the pressure change be very slow, no motion of the basilar membrane will occur; but the mass movement of the liquid will take place through the helicotrema. If the pressure

change be more rapid (i. e., if its frequency be increased) most of the mass movement of the liquid will be exerted upon the basilar membrane, and more through the displacement of definite regions of the basilar membrane, depending upon the frequency of the pressure change, the mass of the liquid to be moved, the weight and stiffness of the membrane, and frictional resistances. If the pressure change be very rapid (very high frequency), the membrane will be displaced only very near its proximal end. All pressures will be eventually dispersed mainly through movement of the round window membrane. Though small amounts of pressure may be dissipated through other structures or regions of the labyrinth, this is not important qualitatively. Whether the terminals of the acoustic nerve are stimulated by a stress between the basilar and tectorial membranes, by flexure of one or both of these, or otherwise, does not at this time concern us. In any case, the amount of any nerve stimulation may be assumed to be a direct result of the motion of these structures making up or attached to the basilar membrane in the area displaced, or, in other words, where the stimulus acts. Any other assumption is unthinkable. The reason for the above outlined action of the cochlea to sound wave pressures is, of course, that at low frequencies the impedences (resistances) caused by the installation of the mass movements are small, and the impedences caused by the elasticity, mass, etc., of the basilar membrane, are large (i. e., not easily moved).

Hence slow mass fluctuations tend to go around by way of the helicotrema and only a relatively small amount are shunted (i. e., passed through by the easiest route) through the membrane, and this, mostly at its distal end, this end having less impedence (i. e., resistance) to the induced mass movement owing to its relative broadness and hence its relatively greater "givability".

At extremely high frequencies of vibration (i. e., of mass movement) the impedence (resistance) caused by the installed vibrations is very great, and the impedence caused by the elasticity, etc., is small; hence the tendency is to shunt the vibrations through the basilar membrane structures, etc.; in other words, nearer to or at the proximal end.

For each single frequency a maximum vibration will pass through the area which has for such frequency the smallest resistance path associated with it, and we may judge pitch by the relative position of the area stimulated.

We may now readily understand why the low notes are registered in the distal whorl, the high notes in the basal whorl, and the mid-

dle notes in the whorl between these two; also, why the upper and lower limits of audibility exist; because if the pitch of a note is too low or too high to focus upon the basilar membrane or cause any perceptible vibration of it, we are beyond the lower or upper limits of audition. Between these two limits the energy of vibrations is transmitted through the basilar membrane and we may sense it as sound.

The exact magnitude, variations, and dispositions of the elements involved can be given only when the dynamical constants of the different parts of the cochlea are known. No matter how else the cochlea functions, it definitely must also and mainly function as outlined above.

The basilar membrane is about 32 m.m. long, and the acoustic terminal nerve elements appear to be quite evenly distributed along it; therefore, considering these elements as acting similarly to tactile nerves (which of course they are, only highly specialized), we may reason that if two frequencies nearly alike cause sound sensation stimulation of adjacent elements of the basilar membrane, the minimum detectable frequency difference will be proportionate to the minimum detectable distance between the separate disturbances on the membrane caused by the two frequencies. The minimum detectable frequency difference will also be inversely proportional to equal elements of distance along the basilar membrane. In other words, the frequency areas become progressively more and more crowded as they approach the basal whorl. The cochlea functions, within an audible frequency range, between about 16 to 20,000 cycles (double vibrations) and since Knudsen's data[3] give the minimum detectable frequency differences in the normal ear, it is possible to calculate the distribution of areas giving the maximum response to each frequency along the basilar membrane. A distribution so computed is plotted in Fig. 6. The 1000 cycle region lies about midway on the length of the membrane, and the spacing of equal frequency intervals decreases as the proximal end is approached. There are reasons for thinking that no very marked maximal areas of vibration occur for fequencies above 16,000 or below 20 cycles, but if they do, the distribution as shown in Fig. 6 would be but little altered.

Fig. 7 shows a hypothetical curve of the vibration amplitude of the basilar membrane along its length, set up by some primary tone of single frequency. A maximum is indicated at point R, and rapid falling off on both sides. The dotted line indicates the amount of movement necessary for minimum audibility, along the

length, assuming the end organs are so nearly alike in response and situation as to require, for all, the same amount of motion for minimum audible sensation. It illustrates well that although the whole membrane vibrates to any frequency, a sensation is aroused only when the curve is above the dotted line, and the greatest sensation is obtained for the nerves near the area of maximum vibration.

Three small curves show three different magnitudes of the first harmonic, having maxima at R_2. Curve a in the presence of the primary tone is not sensed (because masked by the primary) but it alone would of course be audible. Curve c is detectable even in the presence of the primary tone (not masked). Curve b represents some magnitude between a and c which corresponds to a minimum detectable magnitude of the secondary tone. At this intensity *some definite relation must exist between the magnitude of the primary and secondary tones* shown at R_2. Assuming these magnitudes equal at R_2, we may by introducing another secondary tone, explore and measure the amplitudes of motion set up by the primary tone at various points along the basilar membrane (with certain exceptions). We may thus directly measure the amplitude of vibration of the basilar membrane, stating this in units of the minimum audible amplitude of vibration of this membrane. This has been done by Messrs. Wegel and Lane.[1]

Having briefly outlined the method of determining the curve of amplitude of vibration of the basilar membrane in response to a primary tone, and, passing over any discussion or qualification of details, and certain confirmatory data obtained from electrical analogues of the cochlear reactions, we will discuss Fig. 8, outlining the vibrations of the basilar membrane for different frequencies, as determined from experimental data for amplitudes corresponding to the same pressure of .5 dyne, per Cm.^{2} in the external auditory meatus. This corresponds to a sound not so loud as to produe noticeable harmonics. The dotted curve traces the maxima for all frequencies at a constant pressure of .5 dyne in the external auditory meatus for a single ear. The unit is the amplitude of motion of the basilar membrane necessary for minimum audibility, but the scale is arithmetic (hence greatly magnified and apparently out of proportion).

Note that the curves become flatter as the frequency is less. This shows why the character of the vibrations at low frequencies must be less definite—because more spread out. Variations in frequency-sensibility obtained by hundreds of audiometric measurements are qualitatively in agreement with this finding. I have never found

sharp cut-offs in the lower frequencies. At extremely high frequencies it is to be expected that similar curves should also be less definite because their maxima might lie at or beyond the proximal end of the sensation areas on the basilar membrane. The curves of absolute sensitivity of normal ears (shown in Fig. 1) show a sharp drop over 15,000 cycles. Curves of certain types of deafness which we ascribe to lesions near the basal whorl of the cochlea also show sharp drops in the higher frequencies.

It follows that as long as any function remains in the terminal auditory nerves, even though this be limited to but a small portion of the basilar membrane, the ear will be able to detect any frequency if it is loud enough, and that it will best detect those frequencies for which the remaining sensation region is at the time characteristic for this region. Absolute tone gaps or tone islands do not exist. None have been found when a dependable audiometer has been used.

Fig. 9 illustrates the amplitude of vibrations of different portions of the basilar membrane for two frequencies, 1,200 and 3,500 cycles, both at 8,000 times the minimum audible amplitude of vibration of the membrane at each frequency. (This did not represent equal pressures in the external auditory canal.) The secondary curves caused by the subjectively produced overtones are present in each case. Some parts of the middle or inner ear probably produce these overtones, as they were not introduced into the ear from without. The curves show clearly why the perception of one tone is interfered with by the presence of a second tone when their frequencies lie close together, since the mechanism necessary for the perception of the first tone is already stimulated by the second, and therefore less responsive to further stimulation than if it were undisturbed. The curves show how widely separated frequencies may set up stimulation of distinctly different nerve areas, and hence send distinctly different impulses to the brain, and consequently why there is no masking or confusion except such little or none as may normally occur in the brain.

We have hardly mentioned the action of the middle ear apparatus as the data given does not directly bear upon that problem. If the amount of motion of the basilar membrane necessary for minimum audibility at all nerve areas is the same, then the broken line curve in Fig. 8 obtained for minimum audibility data, gives the frequency characteristic of the combined action of the middle ear and cochlear mechanisms. Any determination of the mechanics of these combined mechanisms must be done indirectly from this standpoint. I believe that each type of deafness must show certain

characteristic audiometric changes, dependent upon characteristic discriminations of the different frequencies against certain frequency regions of the basilar membrane structure. I believe we will have to modify our present crude diagnostic conceptions of the air and bone conduction tests.

Do not confuse the theory of resonance outlined above with the theory of distinct resonator fibres in the basilar membrane, each responding to a single tone. It is the various configurations of vibrating form which differentiates the sound impressed upon it. The whole membrane vibrates to all sounds. That we believe to be the true explanation of cochlear action.

If, in my avoidance of technical verbiage I have unduly distorted or misquoted any facts, Mr. R. L. Wegel, who is responsible for the masking data, will straighten them out in his discussion of this paper. If I have allowed the physicists to base their researches upon uncertain anatomical or physiological data, the otologists must determine after they have studied the subjects we have just discussed. A more complete treatment of cochlear dynamics will shortly be presented before the American Otological Society.

REFERENCES:

1. WEGEL AND LANE: Physical Review, Vol. 23, P. 266, Feb. 1924.
H. FLETCHER: Journ. Phys. Test, Vol. 196, P. 289, Sept., 1923.

2. FLETCHER AND WEGEL: Phys. Rev., 19, P. 533, June, 1922.
FOWLER AND WEGEL: Audiometric Methods and their Applications. Transactions of A. L. R., & O. Soc., Dec., 1922, P. 98.

3. V. O. KNUDSEN: Abstract in Physical Review, 19, 261, (1922).

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OCULAR RESPONSES TO VESTIBULAR STIMULATION.

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Interest in the ocular responses to stimulation of the vestibular apparatus has in the past been limited practically to nystagmus in response to maximal stimulation. It is obvious, however, that a mechanism serving the function attributed to the labyrinth must respond not only to maximal, but also to minimal stimulation. This paper is a report on studies of the ocular responses to minimal and normal stimulation of the vestibular apparatus, and physiologic alterations in the responses.

Of the forms of vestibular stimulation which are at present employed, turning most closely approximates the normal form of stimulus. Repeated turning in the same direction is, however, quite evidently abnormal. The closest approach to normal stimulation is change in the position of the head in space through an angular fraction of a turn, or at the highest, through one complete turn. The ocular responses to such a stimulus are two:

First: The compensatory rolling movements of the eyes described by the earliest investigators of labyrinthine phenomena.

Second: A hitherto unobserved heterophoric reaction occasioned by a temporary, induced eye muscle imbalance.

By rolling movements of the eyes, as defined by Barany for the human species, is meant the compensatory eye movements which occur when the head is inclined toward one or the other shoulder.

He has demonstrated that, in the human species, with the destruction of the labyrinth, compensatory movements of the eyes are reduced or absent, whereas with irritative lesions, they are usually increased.

It has been demonstrated in fishes (Selachians) that destructive lesions of the vestibular apparatus cause permanent and fixed displacement of the eyes similar to the compensatory movements elicited by stimulation of the apparatus. These changes have been proven not to be due to irritative changes of either the vestibular or the ocular nerves or centers. Obviously, the vestibular nerve in the fish controls directly and intimately the innervation of the

Editor's Note: This mss. received in The Laryngoscope office and accepted for publication March 17, 1924.

muscles of the eyes, as well as the innervation of the compensatory movements of the eyes. In higher vertebrates and in man, the higher organization of the central nervous system has brough about a degree of dissociation of the two sets of centers, the vestibule and the ocular, that has resulted in subordination of the control of the latter by the former. Possibly there has come about an interposition of secondary centers and tracts, and the increased efficiency of the cerebral influence which has been unquestionably demonstrated in frogs

In addition to the type of eye rolling which Barany defined, there is another which is elicited by rotation of the head in the horizontal plane. This type of movement may be best be demonstrated by ordering the patient to hold his eyes fixed, rotated in a given direction, while being turned. The average adult patient, if turned in the same direction as that in which the eyes are rotated, will find it impossible to hold the eyes fixed in that direction, and will execute uncontrollable, undulatory rolling movements in the direction opposite to the turning, which will endure throughout the period of turning. In children it will often be found that the eyes are fixed in the opposite direction at the end of the turning.

A more interesting phenomenon is that recently observed by the writer in a series of cases and named by him the "heterophoric reaction". In testing for it, the patient is first examined to determine whether any eye muscle imbalance be present. He is then turned once or twice. Re-examination of the eye muscle balance will reveal a change, which may endure for a variable period of time after the period of stimulation. The types of muscle balance changes differ in the various cases examined, and no rule with regard to them has been formulated. In one case with an apparently absolutely normal eye muscle balance, two turns to the left elicited an esophoria in the left eye, the right eye muscles remaining in perfect balance; and an equal number of turns to the right elicited an exophoria in the right eye, the left remaining in perfect balance. In cases presenting heterophoria the degree of the heterophoria was altered by vestibular stimulation.

These reactions indicate that their purposeful nature may be, and probably is, visual fixation. An additional observation, noted in another publication, which points in the same direction, is that the rate of the movements of nystagmus caused by rotational stimulation of the labyrinth varies directly with the rate of turning.

1. Henri observed that the symptoms caused by lesions of the vestibular apparatus in frogs, improves in time. If at the end of the period of improvement, the frog be decerebrated the original symptoms reappear, and if the frog be decerebrated before the experiment no improvement will occur. Comptes Renduis, Soc. de Biologie, LVI, 232.

Contrary to the supposition which has hitherto been held, the writer has found that it is possible in man to alter the nature of the ocular responses to rotational stimulation of the vestibule not only by changing the position of the head, but also by changing the position of the eyes only, with the position of the head unaltered. The experiments were performed by the writer under the following conditions: The patient was seated in the turning chair with his head erect, or in the optimal position for stimulation of the horizontal canals. He was then ordered to roll his eyes upward and outward and hold them fixed in that position during the periods of ten turns. In a normal case the findings after ten turns were as follows:

With eyes fixed straight ahead there was usually no nystagmus.

With eyes rolled outward or upward and outward in the direction of rotation, an undulatory, rotary movement which could not be termed nystagmus.

With eyes rolled outward or upward and outward in the direction opposite to that of turning, a true rotary nystagmus in that direction.

The question arises as to whether this alteration of reaction be a mere peripheral summation of movements of the eye muscles or whether there be a central summation of nerve impulses which induce the reaction. Several observations favor the latter view.

1. In case of paresis of one of the ocular muscles in one eye, the extent of the nystagmus movements is limited in both eyes to that in the squinting eye.

2. The sign described by the writer as the oculo-vestibular reflex, by which is meant the past-pointing which is elicited in patients with normal vestibular mechanisms when they attempt to point while holding the eyes fixed in extreme rotation. This sign is absent if either vestibular apparatus be impaired on the side of the affected labyrinth.

These facts indicate that there exist not only impulses going from the labyrinth to the eye centers, but also impulses in the opposite direction from the ocular to the vestibular centers. Whether this be tenable, and what may be the center at which what Loeb has termed the summation of ocular and vestibular stimuli, takes place is an open question.

The question arises: What is the mechanism of the vestibular response to minimal stimuli? Neither the hydrostatic nor the hydrodynamic theories regarding the mode of stimulation of the labyrinth at present acecpted explain adequately the response of the

mechanism to minimal stimuli, though they do seem to explain the mode of response to maximal and several forms of artificial stimulation. The capillary size of the semi-circular canals and the high viscostiy of the endolymph must render responses to the types of stimulation to be accounted for on the basis of those theories, subject to a high inertia and considerable delay. As a matter of fact the type of responses which we are here considering are fairly rapid and prompt. We are acquainted in every day life with a mechanism which, under conditions similar to those existing in the labyrinth, does respond to minimal changes and serves a function similar to that served by the vestibular apparatus. The spirit level is here referred to. Its modus operandi is the flotation upon or in a fluid of a substance of a different specific gravity, which by its movements in the fluid indicates the level or change of level of the apparatus. It is conceivable that in the case of the labyrinth the floating substance might be the tip of the cupola floating in the endolymph. Although the recent studies contradict the views previously held as to the bodily displacement of the cupola from the crista ampullaris by endolymph movements, there is nothing to indicate that the free tip of the gelatinous cupolary mass does not change its position in the endolymph of the ampulla, thereby stimulating the enclosed nerve ends. Thus, without predicating movements of the endolymph in the capillary semi-circular canals, or changes in hydrostatic pressure, which are both regarded in many quarters as improbable, it is rendered possible to explain on a physically tenable basis the delicacy of response of the vestibular apparatus to normal and minimal stimuli. Undoubtedly, however, the other hypotheses may and do apply to the mechanism of response of the organ to special and probably abnormal stimuli.

230 East 79 Street.

SOME ESSENTIAL FACTORS IN TONSIL SURGERY*.

DR. J. MANUEL MAYER, Brooklyn, N. Y.

The surgical technic in the enucleation of the tonsil has been considered by some observers in the past, and probably is still considered a very simple and safe procedure. I shall endeavor to disprove this fallacy.

I wish to refer to the remarks made by the Paris correspondent of the A.M.A. Journal a few months ago, who reported that at a recent surgical meeting, Dr. Sebileau[1], hospital surgeon of the University of Paris, gave a dramatic account of the death of a young girl from fulminant hemorrhage following a tonsillectomy. A judicial necropsy was held, and a large tear was discovered in the internal carotid artery. The surgeon, against whom a charge was brought, had performed more than five hundred tonsillectomies without the slightest accidents. This tragic incident was undoubtedly due to an anomalous vessel of which I shall speak later.

At this juncture it is essential to briefly review the normal anatomy of the tonsil.

Anatomical Relations. It is an established anatomical fact that under normal conditions, both the external and internal carotids are separated from the tonsillar bed by a considerable space, the distance of which is estimated to be from 2½ to 3½ cm. Under these above conditions, the carotids cannot be injured in operative procedure if reasonable care is exercised, since the vessel is sufficiently remote from the tonsil field. Furthermore, the palatine tonsil is covered by a thin, firm fibrous capsule which is continuous with the pharyngeal aponeurosis. Immediately above this is the superior constrictor muscle of the pharynx, with the bucco-pharyngeal fascia on its lateral surface.

The ascending pharyngeal and the ascending palatine arteries and the tonsillar branch of the external maxillary, in order from behind forward, are in intimate relationship with the structures forming the tonsillar fossa. The tonsillar branch of the dorsalis linguae artery approaches the tonsillar region from above.

Aberrant Vessels. J. Parsons Schaeffer[2], Professor of Anatomy at Jefferson Medical, states that not infrequently the lingual and the external maxillary arteries course near the lower pole of the tonsil

*Read before the New Utrecht Medical Society of Brooklyn, N. Y., February, 1923.

Editor's Note—This manuscript received and accepted for publication in Laryngoscope, February 29, 1924.

and are in danger in careless tonsil surgery. Moreover, he claims that the superior constrictor muscle is at times very thin, almost wanting, so that the tonsillar capsule and the pharyngeal aponeurosis alone intervene between the attached surface of the tonsil and that of the arteries.

He further remarks that an aberrant tortuous internal carotid artery is not infrequent, and that this anomalous state of the vessel is undoubtedly the underlying factor in many cases of visible pulsation of pharyngeal vessels and probably of fulminant hemorrhage during or following tonsillectomy.

Wood[3] reports large pulsating blood vessels in two children, ages 5 and 7 years, respectively. On the right side of the pharynx, he particularly noticed a pulsating vessel about the size of a lead pencil. Tortuosities of both internal carotids were encountered by Edington[4], Rowlands[5] and Swan[6]. Two cases of pharyngeal and tonsillar pusations in adults came to my notice at the New York Post-Graduate Hospital, in which operation was naturally refused. Kelley[7] encountered a number of patients in whom large pulsating vessels in the pharynx were noticed. He cautions that pulsations of the lateral walls of the pharynx often escape notice, owing to their being masked by the involuntary movements of the posterior faucial pillars and adjacent parts accompanying respiration. That the ascending pharyngeal artery is at times of sufficient size to cause fatal hemorrhage, is evidenced by Baker's case[8], in which the ascending pharyngeal artery was injured by a tobacco pipe. Farlow[9] reports eight cases of large pulsating arteries on the posterior walls of the pharynx, the patients ranging in ages from 14 to 68 years.

Brown[10] reports a case of death from hemorrhage in an adenoid operation, necropsy likewise disclosing an injury to a tortuous internal carotid.

Two deaths occurred during my house-surgeonship at the Sydenham Hospital, both operations having been performed by very able men. Post-mortem, however, did not reveal aberrant vessels. These fatalities were due to hemophilia, another salient fact to be dealt with in tonsil surgery.

Local Anesthesia. It has been conceded that with the advent of cocain, its derivatives, and adrenalin, nose and throat surgery has made rapid strides. That mankind has benefited by these discoveries is an undisputed fact; but that mankind pays a very painful price, is shown by the death rate per annum.

To prove this point, Emil Mayer[11], chairman of the committee on advantages and disadvantages of the various local anesthesiae in

rhino-laryngological work, reports twenty-seven deaths in one year (1919-1920), due to local anesthesiae. These reports were ascertained by letters sent to over fourteen hundred surgeons throughout the states, requesting the exact number of fatalities following the use of these drugs. Out of the fourteen hundred addressed letters only three hundred and fifteen replies were received. Naturally, the actual rate is far greater than these statistics show, owing to the fact that these reports were voluntary and therefore incomplete.

Gibson[12] reports a case of poisoning occurring after two applications of a 2 per cent solution of cocain to the throat and tonsils. French reports that a girl of twelve met her death in a few seconds from a hyperdermic injection of twelve drops of a 4 per cent solution of cocain.

Chipman[13] states that one death has resulted from a few drops of 5 per cent solution of cocain dropped in the eye for a minor operation.

Alden[14] has recently reported a case of cocain poisoning in a man 34 years of age, who had been prepared for a submucous operation. After the septal mucosa of the nose had been swabbed with a 10 per cent application of cocain, the man was immediately seized with clonic convulsions, lasting one minute, and he succumbed.

A fresh solution of cocain and its derivitives in each operative case, would to my mind, greatly minimize possible fatalities.

Pulmonary Abscess. Another crucial factor in the surgery of the tonsil is pulmonary abscess following tonsillectomy.

Fisher[15] and Cohen[16] remark that one is not likely to think of lung abscess as one of the complications, for hemorrhage either primary or secondary, naturally looms foremost as the main risk. Occasionally one will recall the possibilities of an otitis media and its sequellae. Yet, when measured by the possibilities of fatal issue, pulmonary complications such as lung abscesses would be by far of greater importance.

Richardson[17] was the first to call attention to this complication by reporting three cases. Bassin[18] reports a series of nineteen cases. Manges[19] reports six cases received at the Mount Sinai Hospital following tonsillectomy in a period of six months. Porter[20] reports two cases of pulmonary abscess following local anesthesia. Chipman[21] advocates the following measures in the prevention of lung abscess during tonsil operation.

1. A patient should not be operated upon until seven days after an attack of tonsillitis or bronchitis.

2. The mouth and teeth should be thoroughly cleaned with some antiseptic solution before operation.

3. Light anesthesia should be used.

4. Tonsil and pharynx should be thoroughly painted before and after operation with a 50 per cent solution of iodine.

5. Bleeding should be stopped at once by suture or ligature rather than prolonged sponging, thus reducing the anesthesia, and obtaining a dry pharynx.

6. Patient should be returned to his room, recumbent on one side with the head down.

7. Foot of the bed to be elevated until the patient has fully reacted, unless the patient has a high blood pressure.

8. Throat and nose operations should receive the same care and skill by both the surgeon and anesthetist as are given to abdominal operations.

Anomalous Styloid Process of the Temporal Bone. There is still another element of importance in the surgery of the tonsil, and that is the anomalous styloid process of the temporal bone, which is not infrequently in close relationship with the tonsil substance. Several cases of this character came to my observation recently.

Under normal conditions the styloid process is slender, pointed and of varying length, projects downward and forward from the under surface of the temporal bone. Its proximal part is ensheated by the vaginal process of the tympanic portion, while its distal part gives attachment to the stylohyoid and stylomandibular ligaments and the styloglossus, stylohyoidus and stylopharyngeus muscles.

The styloid process normally measures about 1¼ to 2 inches (from 3 to 5 cm.). Richardson[22] and Kyle[23] have reported long sharp bony projecting styloids encountered during or after removal of tonsil. Lipschuts[24], of Philadelphia, in a recent article states, that in cases of deflection of the styloid process, where it is longer than normal, it may take an obliquely, medially directed course and lie in intimate relation to the tonsil.

SUMMARY.

1. Tonsillectomy has become an operation of unusual frequency, and in the hands of the untrained, particularly, it is neither so safe nor so simple a surgical procedure.

2. Aberrant vessels not infrequently occur, therefore, the tonsillar field should be thoroughly inspected and adequately palpated for pharyngeal or tonsillar pulsations in all cases prior to enucleation of the tonsil.

3. Toxicity following local anesthesia is a serious factor to be dealt with, therefore preventive measures should be instituted prior to operation.

4. Pulmonary abscess is not uncommon, hence more careful attention should be directed to asepsis and the management of the patient pre and post-operative.

5. A blood coagulation test and also a blood count are essential and should be determined in all pre-operative cases in order to lessen the possibilities of hemophiliae and leukaemiae.

6. Anomalous styloid process of the temporal bone within the tonsillar fossa occurs more often than one would suspect, therefore more careful palpation and extreme caution should be exercised during the operative procedure in order to avoid severe and dangerous mutilation to the pharyngeal musculature.

BIBLIOGRAPHY.

1. The carotid arteries and hemorrhages of the tonsils; Paris letter *J. A. M. A.*, 76; 532 (February) 1921.
2. SCHAEFFER, J. PARSONS: Aberrant vessels in surgery of the palatine and pharyngeal tonsils. *A. M. A.*, (July) 1921.
3. WOOD: Anomalous position of common carotid visible in the pharynx. *A. M. A. J.*, 124; 478, 1902.
4. EDINGTON: Tortuosity of both internal carotid arteries. *Brit. M. J.*, 1901.
5. ROWLANDS: Tortuosity of both internal carotid arteries. *Brit. M. J.*, 1902.
6. SWAN: Tortuosity of both internal carotid arteries. *Brit. M. J.*, 1902.
7. KELLEY: Large pulsating vessels in the pharynx. *Glasgow M. J.*, 49; 1898.
8. BAKER: Fatal wound of the ascending pharyngeal artery by a tobacco pipe. St. Bartholomew's Hospital, 12; 163, 1876.
9. FARLOW: Eight cases of large pulsating arteries on the posterior wall of the pharynx, *Lancet.*, 2; 128, 1915.
11. MAYER, EMIL: Anesthesia in nose and throat work. *J. A. M. A.*, (Oct.), 1921.
12. GIBSON: *Lancet.*, (Feb.), 1910.
13. CHIPMAN: Relation of anesthetic to pulmonary abscess following nose and throat surgery. *A. M. A. J.*, 539, 1922.
14. ALDEN: St. Louis, THE LARYNGOSCOPE; 887, 1923.
15. FISHER: Pulmonary abscess in adults following tonsillectomy under general anesthesia. *J. A. M. A.*, (Oct.), 1921.
16. COHEN: Pulmonary abscess in adults following tonsillectomy under general anesthesia. *J. A. M. A.*, (Oct.), 1921.
17. RICHARDSON: Washington, M. Ann., (May), 1912.
18. BASSIN: Paris, A. Muller, 1913.
19. MANGES: *Am. J. S.*, 30; 78 (March), 1916.
20. PORTER: *Virginia M. Monthly*, 47; (March), 1921.
21. CHIPMAN: Same as 13.
22. RICHARDSON: Same as 17.
23. KYLE: Text book of diseases of nose and throat. Philadelphia, 1914.
24. LIPSCHUTS:

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WHAT CONSTITUTES AN IDEAL TONSIL OPERATION.*

Dr. Secord H. Large, Cleveland, Ohio.

For twenty-five years we have been endeavoring to originate or else assemble from other tonsil operations the best points in order to perfect an ideal tonsil operation. Most of the important clinics in Europe and the United States have been visited. The technique which we employ is a composite of the various types seen in these clinics along with some original ideas.

1. *Pre-operative care:* In all cases a thorough physical examination is made, including urinalysis and recording blood pressure. The blood pressure is taken on the day of examination and again on the day of operation and some weeks after the operation. On the day of operation the systolic rate is found to be considerably higher than on the examining day but the diastolic remains fairly constant. In diseases of the thyroid gland on the day of examination the systolic and diastolic pressure may not be very much higher than normal but on the day of operation it is often found that the systolic pressure is considerably increased, while the diastolic is only slightly increased. The blood coagulation time is taken in every case.

The patients are instructed to take one-half teaspoonful of bicarbonate of soda in water three times a day for three or four days before the operation. They seem to recover more quickly and in some cases where a general anesthetic is given there is less nausea following its use. No cathartics are given. Those patients having local anesthetics are instructed to have their usual morning meal, while those taking a general anesthetic are not allowed anything by mouth on the day of operation.

2. *Hospitalization:* All of our cases are hospitalized.

3. *Anesthesia:* As yet no local or general anesthetic has been found to be entirely free from danger. We have tried nitrous oxid and oxygen, nitrous oxid, oxygen and ether, somniform, ethyl chlorid, both by the open and closed methods, also in conjunction with oxygen administered by means of a monovalve gas machine, ethylene gas, and ether by the drop method. Nitrous oxid and oxy-

Editor's Note: This mss. received in The Laryngoscope office and accepted for publication June 20, 1924.

*Read before the American Laryngological Association, Swampscott, Mass., June 4, 1924.

gen is very pleasant to take but the duration of anesthesia is too short to permit good work and a careful inspection of the throat. Somniform has the same disadvantage. Also ethyl chlorid and ethylen gas. Ethyl chlorid either by the open or closed method and also together with oxygen by means of a monovalve gas machine was administered in over one thousand cases with no fatalities. Many operators are afraid to use ethyl chlorid as a general anesthetic because of its rapid action and absence of danger signs. My associate, Dr. C. W. Engler, who has worked in Dr. J. S. Fraser's clinic in the Royal Infirmary at Edinburgh, informs me that ethyl chlorid by the closed method is used exclusively for general anesthesia in tonsil work there; nineteen thousand cases have been operated with but three fatalities.

Straight ether as a tonsil anesthetic has the same disadvantage as it does for other operative work in the body, viz.: the induction period is anything but pleasant and there is a marked stage of excitement. As a rule there is considerable nausea following the operation. We have been using nitrous oxid and oxygen induction followed by ether. This does away with the strangling sensation and the excitement stage produced in straight ether anesthesia, but the post-operative nausea may occur. The ideal general anesthetic for tonsil operations is one in which the induction stage is pleasant, and free from all struggling, straining, coughing and vomiting, and yet produces a narcosis deep enough to allow the operator to do careful work with sufficient time for inspection, and one also which causes no post-operative nausea. At present we have no such anesthetic.

For local tonsillectomy we have tried various different solutions; as a saturated solution of magnesium sulphate with adrenalin chlorid; it was found that a very great amount of the solution was necessary to secure any anesthesia at all, and even using large amounts failed to make the operation painless in the majority of cases. Alypin solution in one-half per cent strength, together with adrenalin chlorid gave an effect similar to that produced by cocain, there being a very marked excitement followed by depression. Quinin urea hydrochlorid in 1 per cent solution caused sloughing in some cases. The amount of anesthesia produced by a 2 per cent apothesin solution was variable in that some patients experienced considerable pain, while others were free from pain. We are now using 1 ounce of a one-half per cent procain solution with 6 minims of a 1-1000 adrenalin chlorid solution with which we have been able to secure complete local anesthesia. The strength of the adrenalin

chlorid solution which we use is 1-80,000. We feel that any solution stronger than 1-50,000 is dangerous. Great care should be exercised in the use of adrenalin chlorid in cases of hyperthyroidism.

4. *Technique:* In local tonsillectomies the patients were given a hypodermic injection of one-quarter grain of morphin sulphate, while those taking a general anesthetic were given the same, together with one-one hundred and fiftieth grain of atropin sulphate. Small children are given scopolamin grains one-two hundredth by mouth one-half to one hour before operation.

In the cases of local anesthesia 4 minims of a 20 per cent solution of cocain hydrochlorid with 1 minim of adrenalin chlorid, 1-1000 solution, are rubbed in between the tonsil and the anterior and the posterior pillars. Two such applications are made with a cotton-tipped applicator. One swabbing is made to the posterior pharyngeal wall and one to the uvula to prevent gagging. The surface of the tonsil is not painted at all, an effort being made to rub the solution in only on the surface through which the injecting needle is to pass.

All cases are injected with the patient in the recumbent position. Three injections are made in the anterior pillar and one in the posterior pillar. The injections are not made directly through the anterior pillar but in the space between the tonsil and the pillar.

In many cases in adults having a general anesthetic these injections are made before the patients are narcotized, inasmuch as they diminish the amount of bleeding and tend to prevent surgical shock. No injections are made while the patients are in deep anesthesia because of the absence of danger signs.

5. *Asepsis:* It is impossible to have a tonsil operation entirely aseptic but we endeavor to make it as sterile as possible. We have been using a blue sterile sheet which entirely covers the head and shoulders of the patient. There is an opening in the sheet through which the operator can work in the mouth.

After the application of the cocain solution to the pillars and before the injection of the procain solution we swab the area that is to be injected with a 2 per cent solution of iodin in alcohol. We were led to do this because in three cases there was a small tonsillar abscess in the tonsillar fossa following tonsillectomy. We think that the infection was carried from the surface to the deeper structures by the injecting needle.

Our procain solution is prepared by boiling the powder in sterile water in an Ehrlenmyer flask for some minutes. Six drops of 1-1000 adrenalin chlorid solution are added and the entire solution is boiled one minute longer.

A great number of operators do not wear rubber gloves while doing a tonsillectomy. We feel that their use is a protection both to the operator and to the patient.

All tonsillectomies, including those done under local anesthesia, are performed with the patient in the recumbent position. A Klaar reflector is used because the light is not diffused, but can be focused on the area which is being operated.

We have tried various makes of hemostatic tonsillotomes but prefer the Walker instrument with a slight modification by the author. Not all of our cases are bloodless, but at least 75 per cent are, adults included of course. No sponging of the fossae is done unless there is some bleeding. We have given up suction as we thought it favored hemorrhage. It is not so much the type of operation which is done, whether it be a form of dissection or the Sluder method, which counts, but the success of a tonsil operation depends on the ability of the operator, and not on the type of instrument which he uses.

In a few clinics visited, no gentleness was used in operating, lips being cut by the mouth gag and in a few instances teeth were knocked out. The manner in which the Gottstein curette was used certainly must have cause a considerable amount of damage. One operator used 20 drops of adrenalin chlorid to one-half ounce of procain solution for injection in local and general anesthesia.

After operation under general anesthesia the patient is placed in bed on his stomach in order that he may not aspirate any vomitus or blood. Often one sees anesthetized patients transported from the operating room to a distant part of the hospital with no other attendant than an orderly. If during this time the patient should vomit he might aspirate the vomitus and blood. At one of our leading hospitals a patient having had an abdominal operation supposedly drowned in his own mucous. Autopsy revealed, however, that stomach contents were present in the lungs.

As a rule no opiates are administered after the operation, but three tablets of Sedabrol in a cup of hot water are given to the patient if he is restless or in pain. This equals 45 grains of sodium bromid. If the patient experiences much discomfort this dose is repeated in three hours and if necessary is given three times on the following day. Lately we have been giving bromids before the operation rather than morphin, inasmuch as the latter causes some excitement after the period of restfulness has passed. The bromids are given in the following form; sodium bromid, fluid extract glycyrrhiza aa oz. 1, aquae q.s. ad. oz. 4. Sig; one teaspoonful in

water three times a day for three days before operation. In local cases three tablets of Sedabrol in a cup of hot water are given one-half hour before operation.

In some cases considerable comfort was secured by the application of 50 per cent silver nitrate solution to the hyperemic area. Good cosmetic results are also obtained by its use while the white membrane is still present followed by the application of a saturated solution of scarlet red in tincture of benzoin compound after the membrane has disappeared; this stimulates epithelialization in the tonsillar fossae. Within the past month we have been using a powder, which Dr. W. Mithoefer advises for pain with good results. This powder consisting of: anesthesin (Metz), aristol (Bayer), aa. oz. one-half menthol grs. 10, is insufflated into the tonsillar fossae every three hours.

After operation an ice bag is applied to the throat.

The ideal tonsil operation necessarily secures for the patient the maximum degree of safety with the least amount of discomfort both during and after operation. The less the mechanical manipulation the better and quicker the healing.

2323 Prospect Ave.

FIVE CASES OF ETHMOIDITIS WITH ORBITAL COMPLICATIONS IN CHILDREN.

DR. WILLIAM SIEGMEISTER, Brooklyn, N. Y.

Case 1: L. S., 11 years old, admitted to the U. I. Z. Hospital Jan. 3, 1923.

Chief complaint: pain and swelling over right eye.

Past history and family history negative.

Present illness: five days before admission to hospital patient had chills, fever and swelling over the right eyelids following an attack of grippe.

Physical examination: young male, rather delicate, but apparently in good health, resting comfortably.

Eye examination: both lids swollen, closed, moderate protrusion of the eyeballs, limitation of motion upwards and inwards, slight

Editor's Note—This mss. received in The Laryngoscope Office and accepted for publication May 26, 1924.

chemosis of conjuctiva, pupils equal, react to light and accommodation. Media clear, fundus, marked engorgement of central vein, disc outline somewhat hazy and hyperemic.

Nasal examination showed turgescence of right middle turbinate, no pus or mucous visible, no tenderness over any of the sinuses.

X-ray examination revealed marked opacity in right ethmoid region. The rest of the sinuses were clear.

On application of cocain and adrenalin in right middle meatus, followed by suction, pure pus was obtained. Diagnosis of ethmoiditis with orbital cellulitis was made. After a stay of three weeks in the hospital the patient was discharged as completely cured.

Case 2: J. K., 10 years old. Was seen by me on Mar. 10, 1923. Chief complaint: a swelling over right side of face and eye.

Past history: negative. Present illness: two weeks ago the patient had an attack of scarlet fever, which has been running a moderate course, the temperature coming down to normal within one week. No other complications, except for the swelling over right side of the face and right eye, which occurred five days previous.

Physical examination: young male, well nourished, apparently in good health.

Eye examination: marked swelling over both lids, which were closed, eyeball protruding, motion limited, marked tenderness over roof of the nose and right super-orbital region.

Nasal examination: pus in the right middle meatus between middle turbinal and lateral nasal wall. Puncture of right maxillary antrum showed pure pus.

X-ray examination: opacity over right ethmoid maxillary antrum and frontal sinus.

Diagnosis: pan-sinusitis on right side with orbital cellulitis. This condition cleared up within three weeks.

Treatment consisted of shrinking with adrenalin, lavage and suction.

Cases 3, 4 and 5 presented a similar picture. The ages were respectively 1 year, 14 months and 5 years. They all had orbital cellulitis, which was manifest by swelling of the lids, exophthalmus, fixation of the eyeball, following attack of grippe. All had at the same time double purulent otitis media. On examination of the nose pus was found in the middle meatus. The clinical picture being so self-evident, no X-ray was taken. They all cleared up within one to two weeks. Treatment was the same as above.

These cases are being reported by me not on account of the rarity of their occurrence or special difficulty in diagnosis. On the con-

trary, to my mind sinus disease in children is present more often than it is usually supposed. It is overlooked by the rhinologist, pediatrist as well as the general practitioner. The reasons are many, among them being the difficulty of examination, and the general prevailing opinion that the nasal accessory sinuses are entirely absent in children, which is fallacious. The exhaustive studies of Onodi, Schaefer and Davis on numerous skulls and wet specimens from early fetal life to adolescence have proven that the sphenoids, ethmoids and maxillary sinuses are present at birth. The ethmoids have as many cells at birth as in the adult. Dean in his monograph in Abt's System of Pediatrics describes numerous cases of sinusitis in children ranging from the age of 7 months upwards. Many of them were diagnosed only at autopsy. Yet most of thoses cases go unrecognized; they parade under the diagnosis of grippe, nasopharyngitis, etc. Even when complications do arise they are treated for the secondary lesion. All the cases I am reporting had been treated for eye conditions before they came under my care. I wish to impress on the profession the necessity for examination of the sinuses of children, regardless of age, in all cases of profuse nasal discharge. This should be supplemented by X-ray examination if the condition warrants. The X-ray is of great value in all sinus examinations, more so in children than in adults. It gives us valuable information as to the size and degree of development of each sinus and some idea of its condition.

Regarding complications, we find them occurring more often in children than adults on account of the softness and porosity of the bones of the sinus walls and of dehiscences.

The prognosis when complications do occur is much better, inasmuch as most of the cases are of acute origin, while in the adult they are mostly acute exacerbations of chronic sinusitis.

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FUNGUS ON THE TONGUE.

DR. DOUGLAS MACFARLAN, Philadelphia.

There was a time in the early days of the past medical generation when the use of the microscope was popular and universal. It was in this time that there was observed and classified a host of vegetable parasites and saprophytes, the fungi, that were occasionally found attacking the human organism. The external auditory canals was a usual location to find the fungi, and it is singular to note that this was the only place where they were found by the early ear, nose and throat specialists. In Burnett's System of Diseases of the Ear, Nose and Throat there appears a very full article by Barclay on the classification, symptomatology and treatment of fungous invasion. The article is mentioned as a reference and for the purpose of avoiding the consideration of conflict of opinion that exists as to definite classification of fungi.

As elsewhere in nature, fungi implanted in human tissues exhibit a surface growth which perpetuates itself by two forms of reproduction, sexual and asexual. The vegitative state is represented by the growth of thread-like processes of protoplasm (hyphae), which branch and intermingle so abundantly that they form a "web, membrane or stratum (mycelium) like felt or blotting paper, close to or penetrating its nutrient medium". Submerged hyphae are thrown down like roots into the tissues. A sexual reproduction appears as the fusion of contiguous branch cells, the protoplasm of the fused cell developing into a zygospore or resting spore. These spores are so-called from the fact that "the germinal elements therein contained usually retain in quiescence their specific functional potency for a very long period before being themselves discharged". The sexual reproduction is shown in the protrusion from the surface of the mycelium of stalks (sporangia) which swelling at their tips develop within the pod-like bud a myriad of minute spherical masses, the spores. In the case about to be cited these spores are black (aspergillus niger).

Case: Helen S., age 22, had a tonsil operation about three weeks prior to her appearance, with a whitish fur on the dorsum of her tongue. This furring was different in appearance from that seen commonly in gastric upsets; the coating was thicker, most tenacious, and plush-like. An applicator could be used to waft the wet strands from side to side. The color was just "off" a clear white. The circumvallate papilla were very slightly inflamed and elevated.

Editor's Note: This mss. received in The Laryngoscope office and accepted for publication April 4, 1924.

On using a knife to scrape away the growth, it was found to be tenacious and seemingly bound down to the tissue of the tongue. The "feel" of the tongue was as though one was touching a surface coated with a loose texture of wood fiber. Under the microscope it was easy to distinguish the matted fungus strands (hyphae).

On looking up the literature on the treatments recommended I found as many remedies suggested as there were authors on the subject. The use of alcohol seemed to be endorsed by many, but tried in all strengths, it did not affect my case in the slightest. Equally negative results were obtained with idodin, chlorin and salicylate solutions; hyposulphites were tried without effect. The course of the case became annoyingly protracted, and though there were no subjective symptoms and no spreading of the growth the

Drawing of a magnification of microscopic slide showing a Mouth Fungus. The hyphae appear as ribbons—the sporangia have ruptured scattering black spores.

young girl was very annoyed by what she thought was a noticeable disfigurement. There was occasionally noticed a displeasing odor to the breath and I cannot say that I can compare this odor to anything I have ever noticed before. It was impossible to describe. The annoyance to the patient was markedly increased during the second week that I saw her, when the whole growth turned charcoal-black. This I naturally suspected as a sporulating stage and it proved to be such on microscopic examination. Strangely enough this sporulation recurred regularly every two weeks and lasted for about three days.

A variety of dies were now tried without benefit, then silver nitrate solutions were resorted to. This also was ineffectual. Finally a scheme was hit upon which brought results. The tongue was smeared with a heavy solution of glycerole of tannin, and

immediately there was applied a 25 per cent solution of nitrate of silver. The silver precipitated immediately and the tongue was blacker than ever; but in a few days the blackness was disappearing rapidly by what appeared to be a separation of the fungus from the tongue beneath. Scraping with the knife helped the removal and an other application of tannin and silver was made. Again on her return the fungus seemed to be disappearing. There was now tried the silver nitrate solution first and the tannin afterwards. But no precipitation occurred; and the first method was again resorted to. Within two weeks time the condition that had resisted treatment for two months had cleared up. The case is cited for its rarity, its peculiar change in appearance from a white tongue coating to a black (when sporulation occurred), and for the singular treatment.

1805 Chestnut Street.

TONSILLECTOMY FOR VINCENT'S ANGINA.

DR. JAMES ALBERT MORGAN, Honolulu, T. H.

K. P., white, male, age 26, school, physical director.

The tonsils have always been very large but patient is not able to recall a time when they gave rise to any disturbance until the sore throat for which he sought relief.

A deep ulcer in the inferior pole of the left tonsil covered with a dirty gray membrane was readily apparent, and the cervical glands were swollen and indurated.

Temperature was normal. Smears and cultures were negative for Kleos-Loeffler bacilli, but the smears showed many of the fusiform bodies and spirillae typical of Vincent's angina.

Local treatment for three days gave no relief.

The ulcer had assumed large proportions in the meantime and the accompanying dysphagia became more severe. As the ulcer was confined to the tonsil, there being no involvement of the surrounding mucous membrane, it was decided to remove the tonsils at once.

There was no unfavorable post-operative reaction and no elevation of the temperature subsequently. The healing was particularly rapid and by the second day the patient was able to take soft food without much inconvenience.

48 Young Bldg.

Editor's Note—This manuscript received and accepted for publication in Laryngoscope, Feb. 14, 1924.

COMBINED SUCTION AND TONGUE DEPRESSOR.

Dr. Foster A. Beck, Allentown, Pa.

The unsatisfactory methods in use to keep the mouth and throat free from saliva, mucus, and blood, and keep the tongue depressed, while operating, led me to devise an instrument, the use of, which will keep the mouth and throat free from all secretions, and keep the tongue depressed at the same time.

The combined suction and tongue depressor is made of *steel, nickel-plated.* The instrument is well balanced and designed so as to give maximum strength with minimum weight. The distal end of the blade is especially wide so as to keep the tongue from coming up along the side to obstruct the view, or be in the way of the part to be operated on. The openings in the blade and the grooves on the under surface of it are designed so as to give the

greatest amount of traction possible. The handle is constructed so that the hand cannot slip off and that it can be held firmly. The suction tube is fastened to the top of the blade, extending beyond the distal end, and passes down the handle extending beyond its lower extremity. There are seven holes in the distal end of the tube (B), through which the secretions enter. The lower end of the tube (A) is connected to a suction pump, or Brawley's hydraulic suction apparatus, by means of a suitable length of flexible rubber tubing.

The instrument, with suction apparatus working, should be given to the anesthetist as soon as the anesthetic is administered, and

Editor's Note: This mss. received in The Laryngoscope office and accepted for publication, June 9, 1924.

should be used at anytime when necessary to remove mucus, or vomitus from the mouth and throat before the patient is completely anesthetised. By using this instrument, the surgeon or his assistant can depress the tongue, and at the same time keep the field of operation free from all secretions, therefore, making the operation less complicated. In case of tonsillectomy and adenoidectomy, one tonsil is removed the end of the depressor is directed toward the fossa and all blood is instantly removed, therefore leaving the throat clean and making it easier for removal of the second tonsil. After the tonsillectomy the adenoids are removed. The end of the depressor is directed toward the posterior pharyngeal wall, and all blood coming from the naso-pharynx is removed. In case of hemorrhage the bleeding vessel can be easily located, and is then clamped with a hemostat and ligated. Should a blood clot be drawn into the openings of the tube and stop the suction, remove the depressor from the mouth, wipe off the clot, and it is then, again, ready for use.

ADVANTAGES.

1. The use of this instrument keeps the mouth and throat free from all secretions, therefore making it easier to do the operation, and eliminates sponging.

2. Less blood is swallowed, therefore vomiting is less frequent, and the toxic material absorbed from the blood in the intestinal tract is eliminated.

3. Little or no blood is drawn into the lungs, therefore, the frequency of broncho-pneumonia, as a complication, is reduced.

4. The instrument is a great aid to the anesthetist. By its use mucus or vomitus can be removed from the mouth and throat, at any time, while administering the anesthetic.

5. The instrument is so constructed that it can be easily cleaned and sterilized. The suction tube is cleansed by drawing warm soapy water through it, followed by ether.

Note: The instrument is made by Geo P. Pilling & Son Co., Philadelphia, Pa.

402 Hanover Ave.

RADIUM APPLICATOR FOR UPPER AIR AND DIGESTIVE PASSAGES.

Dr. J. Maliniak, Cincinnati, Ohio.

The application of radium in the treatment of malignant tumors has been universally adopted with more or less restrictions. Aside from the necessity of a profound knowledge of the physical and chemical properties of radium, the question of technique at first sight may seem secondary but to the laryngologist it is in reality of prime practical importance. Although the application of this salt or its emanations in other part of the body does not present any technical difficulties, it is another question when we have to place it in the upper air or digestive passages, as the larynx, hypopharynx and esophagus. If one works with small doses the application of radium in other parts of the body can be prolonged and repeated without any discomfort to the patient, but in the larynx and esophagus it is different. Having to do here with a region difficult to reach, in which manipulations are unpleasantly trying for the patient, it is necessary for us to limit to the minimum the number of sittings and at the same time to choose that form of salt which occupies the smallest space with the largest dose. The organs with which we are dealing having restricted dimensions require the placing of a corresponding small tube of radium salt. We can use in a larynx narrowed by a tumor only a limited amount of radium. The radium emanations, however, having the same action as the radium salt, can be applied in a dose 15-20 times as large in the same space (same m.m. in diameter). So, practically, we work with the emanations which may be contained in large amounts in fine glass tubes placed in brass, silver or other containers. Doses of 500-1000 millicuries can easily go into a narrow tube and be placed in the larynx, hypo-pharynx or esophagus. Small quantities of emanations in the form of seeds fixed in capillary tubes can be placed in some tumors and left there permanently (one millicurie implant in each square centimeter of tumor mass) since the seeds lose their intensity in about thirty days and we leave them there as small sterile foreign bodies which absorb in time. But although the indication for these seeds is presented very often in the treatment of neoplasms of the tongue and tonsils, it is another question

Editor's Note: This mss. received in The Laryngoscope office and accepted for publication June 27, 1924.

with organs more inaccessible, such as the larynx and esophagus, which require special technique and larger doses.

PLACEMENT OF RADIUM CONTAINER IN THE UPPER AIR AND DIGESTIVE PASSAGES.

The intense action of the salt or its emanations in healthy as well as diseased tissue makes necessary an exact localization of the radium container under visual control and the stability of its fixation. If one takes into consideration that the regions to be treated are very frequently infiltrated and edematous, that bleeding and abundant

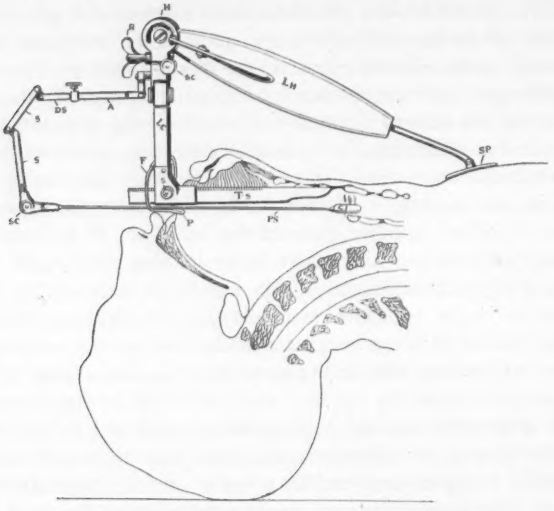

Fig. 1. Laryngoscope of Seiffert in place with adjusted laryngeal radium applicator. L.H. L.C. The two arms of the laryngoscope. H. Hinge articulation between the arms, regulated by a ratchet and a lateral handle. R. Vernier for finer adjustment of the two sections of the laryngoscope. F. Frame carrying on its inferior border a plate (P) to be applied against the upper incisors. T.S. Tongue spatula movable in a slide by means of a double screw (S). S.P. Sternal plate. A. D.S. P.S. Laryngeal radium applicator fixed to the laryngoscope.

salivation may obscure our view and that anesthesia under these conditions cannot be complete, we must recognize the impediments to be overcome.

The indirect methods cannot overcome all these difficulties. One of these, very conscientiously elaborated in America by Freer[1] (Chicago), consists in introducing and maintaining the radium in the larynx by means of a radium applicator constructed individually for each patient, with a double wire, one of the extremities of which is fastened in an opening of a radium container. This rod is

formed of copper, brass and lead and must be bent with correspondingly heavy forceps in order to keep it exactly between a forehead clamp and the place to be treated in the larynx. This firm forehead clamp is fastened to the patient's forehead by means of a heavy headband. The radium container which, as we have said, is fixed to one end of the rod, is introduced into the anesthetized larynx under the guidance of a laryngeal mirror while at the same time an assistant brings the other end of the rod into the clamp. In order to introduce it into the clamp, and at the same time to

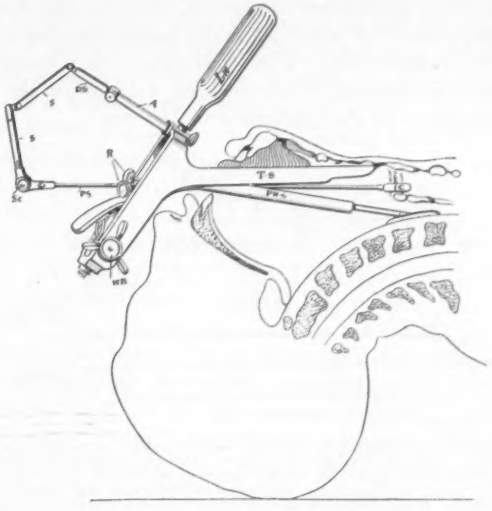

Fig. 2. Hasslinger's laryngoscope in situ. L.H. Handle of the laryngoscope. T.S. Tongue spatula. Ph.S. Pharynx spatula with self adjustable pharynx plate. R. Two rods which move this plate in the pharynx spatula. W.B. Wing bolt which causes the tongue and pharynx spatulae to open or close.

keep the radium container in the exact position in the larynx, the rod must be melted in the fire many times during the sitting and correspondingly bent. And whenever the place of application is to be changed, the bending and placing of the applicator must also be adjusted.

We see from this description the difficulties and imperfections of this indirect method. The disadvantages are felt by the patient and by the doctor and influence unfavorably the object of the intervention.

1. The patient has to be in a sitting position with his head immobilized by the radium applicator fixed between a screw in the frontal band and the larynx. Therefore, the least movement of the head, which is inevitable during the one to one and one-half hours of manipulations in the larynx, affects the position of the radium container.

2. Saliva which accumulates abundantly in the larynx and mouth in this position, must be continuously aspirated, thus provoking a reflex cough, masking the view of the observer and displacing the tube.

3. The exact adjustment of the rod, which is not an easy matter, demands hours of work while the patient remains seated and submits to repeated trials. The cocainization, as is readily understood, must be continually repeated on account of the duration and the repetition of the application of the rod.

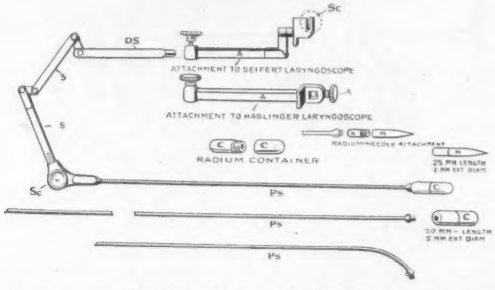

Fig. 3. Laryngo-esophageal radium introductor. A. Attachments to the laryngoscope. I.P. Intermediary plates. D.S. Section with a sliding rod for (A). P.S. Proximal rod with radium container (C) three lengths. N. Needle shaped container for radium emanations. S.C. Double articulation for sagittal and horizontal displacement of the proximal section (P.S.).

4. Finally, the position of the tube in the larynx depends on too many factors to remain exactly in place; involuntary movements of the head, slight inexactitude of the curvature of the rod, a cough provoked by the abundant stagnation of the saliva, etc.

5. Aside from all these disadvantages, the indirect method cannot be applied for the treatment of the esophagus mouth and trachea.

It is to the direct method, which is most simple and most easy to carry out, that we give preference. We have already described the laryngoscopes of Seiffert[2] and Hasslinger, which are best suited to an extensive exposure of the larynx, trachea and hypo-pharynx. The radium introduction is made in recumbency with the head on the table, a position much appreciated by a patient enfeebled by the disease and the previous morphin injection. The position favors

also the discharge of saliva. Figs. 1 and 2 show both laryngoscopes in place with our adjusted radium introductor.

The radium applicator which we have constructed is principally to be used for the respiratory and upper digestive passages as larynx, trachea and hypo-pharynx, since it permits us on account of the extreme slenderness and pliability of the instrument to apply radium to all parts of these tracts (Fig. 3). It can be used on the esophagus in some special conditions, which will be mentioned later.

Construction: It is constructed of four metallic sections, articulated to one another by joints moving sagittally. The proximal laryngeal section (P.S.), which carries on its end the radium container (c), is articulated to the adjoining section by a double articulation (S.C.), which permits it to be displaced sagittally and horizontally. It is fixed in place by a thumb screw. The distal section(A) is hollow and accommodates a sliding rod (Fig. 3, D.S.) to increase or decrease the length of this section. Its adjustment with each laryngoscope is different according to the structure of the instrument. (Fig. 1A and 2A.) An adjustment can be adopted to any kind of laryngoscope or suspension instrument. It is articulated with the spatula carrier (Fig 1 L.C.) of the laryngoscope of Seiffert by an intermediary plate (I.P.), forming thus an inseparable whole. The intermediary plate for the Hasslinger laryngoscope is fixed to its handle (L.H.) by a set screw. (Fig. 2.) The proximal rod, carrying the radium container (C. or N.) is fixed at the distal end by a lateral screw and can be introduced separately with the radium container screwed to its extremity. Three lengths are necessary for this proximal arm to reach the larynx and the esophagus from its mouth to its cardiac end. (Fig. 3 P.S.) On account of the play of the articulations as a whole with a mobility both vertically and horizontally, the radium container may be fixed exactly at the place desired. Moreover, the view of the operator is not obscured as the instrument is so easily displaced sagittally and the sections are extremely narrow, thus allowing a perfect control in the laryngoscope. The radium introductor is mobilized about one fixed point, which is the point of fixation of the intermediary plate. Its position in place is shown on the radiogr. of the patient taken during the radium application (Fig. 4).

Indications: The indications for the introduction into the larynx are the most important. As a general rule, all neoplasms of the larynx should be treated operatively as soon as possible. The invasion of the glands and even their deep adherence and tissue involvement is not an absolute contra-indication to surgical interference.

The only contra-indications to operation would be the invasion of the large vessels on both sides of the neck or an extensive invasion of the esophagus wall. Also, diffuse neoplasms of the pharynx are generally inoperable. In these tumors, particularly those of the larynx, radium treatment must be tried, since prolonged improvement has been obtained. We observed similar cases in Paris at the clinic of Prof. Sebileau and more recently in our work at the clinics of Gluck and Soerensen. The same conclusions were also reached by Prof. Moure and Hautaut in their report on this question at the O. R. L. Congress at Paris in 1921. In the case of a cancer limited to one vocal cord, especially in its anterior part, and not involving the anterior commissure, a limited intervention consisting of a laryngo-fissure with wide excision of the cord to include the cartilage may cure the patient. The corresponding glands of the neck, which are almost always involved, at least microscopically, have to be removed. But these neoplasms, localized entirely in their development, should be prophylactically treated with radium after their removal to destroy any cells which might have escaped the observation of the operator.

Regarding the esophagus, numerous methods of introducing the radium have been proposed. The action of radium from the outside on the esophagus is generally found to be insufficient.

1. A radium container, fixed on a thread and swallowed, remains above the tumor when the latter produced a stenosis of the esophagus.

2. A practical method is that of Guisez,[3] in which the radium container is suspended in an olivary hollow catheter (No. 20 Fr.), which is easily introduced into the esophagus. The indispensable condition for making this introduction is the presence in the esophagus of an opening sufficient to allow the introduction of the catheter holding the radium. The preliminary examination with the esophagoscope gives the distance of the lesion from the superior dental arch. When this distance is indicated on the hollow catheter with the radium suspended in its distal end, it can be placed precisely in front of the desired place. The wire thread holding the radium is fixed at the upper end of the catheter and the latter is held in place by a double thread around the occiput.

In case of an opening insufficient for the introduction of the catheter, the esophageal structure may be carefully dilated without danger with a filiform bougie and our radium container introduced through an esophagoscope. The tube of the esophagoscope is then removed and the carrier fixed on the radium introductor.

Advantages of our radium introductor are as follows:

1. It can be used with any laryngoscope as those of Seiffert or Hasslinger or with a suspension instrument.

2. The introduction and control is done under direct vision of the larynx, trachea and esophagus.

3. No reintroduction is necessary as, on account of the play of the different articulations acting in all planes, we can easily fix the radium container exactly at the position desired.

4. On account of the stability of the instrument, a changing of the position of the radium container caused by movement of the patient's head or coughing is eliminated, which is the prime objection to other methods of radium application.

5. It may be used in certain conditions in the esophagus.

BIBLIOGRAPHY.

1. FREER, OTTO T.: A Radium Applicator for the Larynx. THE LARYNGOSCOPE, No. 5, March. 1920.

2. MALINIAK, J.: The Laryngoscope of Seiffert, Its Indications and Advantages Over the Suspension Method. *The Cincinnati Journal of Medicine*, No. 8, 1924.

3. GUISEZ, JEAN: Diagnostic et Tratement des Retreceissements de L'Oesophage et de la Trachee. Paris, 1923, Masson, Editeurs.

Groton Building, 7th and Race.

THE NEW YORK ACADEMY OF MEDICINE.

SECTION ON OTOLOGY.

May 23, 1924.

The Treatment of Brain Abscess. Dr. Joseph E. J. King.
(*To appear in a subsequent issue of* THE LARYNGOSCOPE.)

DISCUSSION.

DR. PHILLIPS said that Dr. King had outlined a very radical, though apparently reasonable method for the surgical treatment of brain abscess. As he had listened to the paper and recalled his conversation with Dr. King about these experiences, he could not help but permit his mind to dwell upon the great improvement and growth of knowledge regarding brain abscess that has developed the last three decades. In the early days of his studies no operations for the relief of the brain abscess were attempted. It is true that neurologists recognized the symptoms while the post-mortem table revealed the true condition. As time went on and the modern mastoid operation became developed various operators attempted to save the lives of the victims with an occasional success. During recent years the proportion of successful cases had increased. Some of those early cases gave every promise of success for days, even weeks; such patients returning to their usual routine of life, when suddenly the explosion would come with a fatal termination. It would seem that the more modern method of attacking brain abscessses through trephine openings in the skull is the one which has come to stay. Dr. King had certainly had some brilliant successes, but "one swallow does not make a summer" and the accumulation of many of these cases will be required to prove the value of the method. It was certainly a very unusual experience to have four successive recovies from brain abscess, and that was a strong argument in favor of the procedure. It should be tried very thoroughly, and if all would attack the problem from this standpoint with the object of determining whether it has the virtue which it seems to have from Dr. King's experience, valuable statistics would be obtained. It requires the accumulated evidence of a large number of cases to enable any conclusions to be drawn.

Dr. Phillips then asked Dr. King to go a little more into detail as to whether at any point after the operation he released the dura of the flaps of the scalp to help it fall back into place. Dr. Phillips said he had known about some of this work while it was in progress and had been very much interested in the paper and demonstration as presented.

DR. HENRY ALSOP RILEY said: I have listened to Dr. King's presentation with a great deal of interest and much hope, for few fields of effort in neuro-surgery have been so disappointing in their results as the surgical treatment of brain abscess. I believe that Dr. King's method offers distinct promise of improvement in the treatment of these conditions and that it should be thoroughly tried out in view of his success with this series of cases.

I can quite appreciate the conservative viewpoint taken by Dr. Phillips in regard to this rather new method, but I feel more optimistic than he apparently does.

In regard to the neurological aspects of the situation, namely, the removal of a certain amount of cortex in the course of the operation, I do not believe in general that this is of any major significance. The three sites mentioned by Dr. King as the most usual for the incidence of a brain abscess following sinus disease, namely, the cerebellum from middle ear and mastoid disease, the temporo-sphenoidal lobe from the same focus of infection and the frontal lobe from frontal sinusitis, are fortunately relatively silent areas, particularly both temporo-sphenoidal

lobes and the right frontal lobe. I believe that no demonstrable derangement in function will result from this type of operative procedure in any of these three localities.

As for the left frontal lobe, I believe the possibility of neurological evidence of disordered function following this type of operation is possible but not very probable unless the site of the lesion were in the immediate vicinity of the left frontal convolution, in which case one might obtain a motor aphasia.

In regard to the cerebellum I believe the operative procedure is somewhat more questionable in view of the fact that the herniation of a considerable portion of one cerebellar hemisphere might markedly interfere with its synergic function. I would hesitate to criticise any point in the surgical procedure and yet it would seem to me that the removal of the needle after localization of the abscess might serve to spread infectious material in the sub-dural or sub-arachnoid spaces and I would consider it to be technically better to leave the needle in situ until after the blocking off of the sub-arachnoid space is accomplished, after which the abscess cavity could be entered along the side of the needle.

I would be interested in knowing whether these three cases are selected cases or whether they represent all of the patients with brain abscess upon whom Dr. King has operated in the past three or four years. If this is a group of successive cases I have nothing but congratulations for Dr. King's method of surgical approach.

DR. EAGLETON expressed great appreciation and admiration for this work of Dr. King, for it was based on the right principle. For a long time he had been wondering why it was that traumatic abscess had a high rate of recovery while abscess due to infection from the ear or from the nasal sinuses had high mortality. We acquired that information during the war: Fracture of the skull, in which a piece was driven in, formation of an abscess, encapsulated or non-encapsulated recovers; but abscess from the ear and from the accessory sinuses, situated near the surface; we drain them, and all are delighted and everything apparently doing well, and suddenly it spreads and the surgeons again exploring, get much pus.

The proportion of recovery in cases of cerebellar abscess of the ear does not go above 15 per cent, and goes as low as 10 per cent; if we are honest with our figures; in other words, of the cerebellar abscesses as we see them today, only about 1 in 10 get well, perhaps 1 in 8. The others die in the hospital, and nothing is said about them.

Of the temporo-sphenoidal abscesses, only about 33 per cent recover. Dr. King has taken the clinical fact that traumatic abscess gives a higher rate of recovery than those due to thrombi, and has boldly converted an abscess of thrombo-phlebitis origin into a traumatic abscess; and that is a good principle. Dr. Eagleton said he was overcome with admiration for the man that would do this, and with the definite results that followed. He did not know that such work was being done; and Dr. King had done more to solve the problem of brain abscess than has been contributed in a long while; for not a single important thing has been adde since the time Sir William McEwen, in 1890, made his invaluable contribution. Dr. King did something that we have all been afraid to do, and he reports a higher rate of recovery than we have ever had. Dr. Eagleton said he himself had never had three consecutive cases of brain abscess recovery; taking them all together, he has had about 25 per cent of recovery. The profession today was under great obligations to Dr. King for this work of constructive thought.

DR. MAYBAUM: The splendid contribution of Dr. King points in all probability to a real advance in the treatment of brain abscess. The measures, until the suggestion made by Dr. King, were those followed with little change for many years.

Dr. Maybaum would like to have Dr. King enlarge upon the point of avoiding extension of infection to the meninges as a result of his radical procedure. Would it not be advisable to a two-stage operation if con-

ditions permitted? Dr. Eagleton in his writings upon the subject drew attention to the fact that where complete evacuation of a brain abscess can be obtained at the time of the original operation, the chances of a cure are far greater. This is one of the reasons for the successful results obtained by Dr. King. Another factor is the effective method of treating the annoying and often serious problem of herniated brain. Dr. Maybaum asked Dr. King as to whether he believed such good results could be obtained in multilocular brain abscess.

DR. KING expressed his thanks for the discussion of his paper.

Replying to Dr. Phillips' inquiry about the release of the scalp flap after the hernia had formed, he stated that this point had been passed over in the reading of the paper on account of the lack of time. He stated that the scalp flaps were sutured back by taking one suture at the apex and fastening it back to the base of the flap. This was done in order to prevent the apex of the flap from turning in and becoming adherent to the remainder of the flap. He had had such an experience in one case in which the apex of the flap had not been turned back: it turned inward, became adherent to itself and the hairs grew out and irritated the surface of the brain hernia at this point. In this case the area described was the last to heal, on account of the irritation from the outgrowing hairs. After about the sixth to eighth day when the hernia has reached its maximum size, the apices of the scalp flaps are loosened and allowed to fall back against the lateral surface of the hernia to which they become adherent. About the fourth to sixth day the narrow iodoform gauze strips which had been placed about the dural margin to wall off the sub-dural and sub-arachnoidal spaces are removed. To prevent pocketing about the bases of the flaps, that is between the base of the flap and the hernia, a small piece of gauze, wet in Dakins solution, is inserted on successive days, each day being inserted to a less depth, so as to allow this space to become obliterated. The scalp flaps then become well attached to the hernia and as the hernia recedes during the post-operative course with dakinization, the scalp flaps follow over the receding hernia in a manner similar to a street elevator door closing over the space through which the elevator descends. When the wound is completely healed there is left only a small area, triangular in shape, which is covered with a non-hair-bearing scar and represents that space which exists between the margins of the scalp flaps. This is the scar which is later excised at the time a scalp plastic is done and the scalp edges approximated.

Dr. King agreed with Dr. Riley about the silent area of the right frontal lobe and to a less extent in the temporo-sphenoidal lobes. He had had no cases of cerebellar abscess and he doubted if this procedure would be as successful in cerebellar cases as in cases in which the abscess is located in the cerebrum. Neither did he think that any other type of operation would be equally successful in cerebellar cases.

The four cases reported were operated upon consecutively according to the procedure described. None had died. The fourth case was really a case of traumatic brain abscess with an external discharging sinus. Such a case should not rightly be classed as a brain abscess. The pathology and prognosis in this type of case differ from that of a true brain abscess. All other cases of true brain abscess operated upon by Dr. King, following other methods, improved from the operation but subsequently died. He had treated a number of "brain fistulae" which were not brain abscesses in the true sense, in the army and most of them recovered after removal of the foreign body and prolonged drainage. Some of the cases drained from six to twelve months or longer, however, when the sinus finally healed and the men were discharged. It is not known whether any of the cases recurred or not. On the other hand, the fourth case reported treated by this method healed in about six weeks and was discharged from that hospital the fortieth day.

In reply to Dr. Maybaum's question as to how infection was prevented when the exploring needle was removed, he stated that in two of the cases there had already formed protective adhesions between the dura

and the cortex and probably this accounted for the fact that no extension of the infection occurred. In one case, the dura was not adherent: as soon as the small incision in the dura was made through the trephine opening the cortex tended to force itself into the small incision so that the sub-dural and sub-arachnoid spaces were cleared off. This probably accounted for the fact that there was no extension of infection. In addition, the operative field was continuously sponged with Dakins solution with gauze wet in Dakins solution which combatted infection. All of the cases operated on were large abscesses with a rather small amount of overlying cortex so there was no danger of not being able to locate the abscess again after the cranial defect had been sufficiently enlarged. In the case of basal abscess, that is a small abscess located at the base of the brain at great depth, it is believed that the exploring needle should not be removed after pus had once been obtained, on account of the likelihood of "losing" the position of such an abscess.

In reply to Dr. Riley's question concerning the herniation of multilocular abscesses, Dr. King stated that one of the cases, that is, the third one, was a multilocular abscess in the sense that there were three extensions of the abscess. There was, however, no distinct separate septum between these pockets in the sense that there were three distinct separate foci. All were confluent. This abscess was non-incapsulated. In this case the hernia cerebri was the largest observed in all of the cases. During the herniation, however, all of the abscess cavity, that is, the three extensions herniated out through the cranial defect completely.

In reply to Dr. Eagleton's inquiry as to actually removing the cortex overlying the brain abscess and the method of dealing with the abscess cavity itself, Dr. King stated the following, which was merely a repetition of what had already been stated in the paper: After the six pennant-shaped dural flaps had been reflected over the margin of the cranial defect and the sub-dural and the sub-arachnoid spaces had been packed off with three narrow strips of iodoform gauze to prevent extension of infection into these spaces, the abscess cavity was then punctured with a needle to again definitely locate its position. A fine pointed sharp knife was then inserted into the abscess cavity, making an incision about a quarter of an inch long. A soft rubber catheter was then introduced and by successive aspirations and filling of the abscess cavity with Dakins solution the pus was grossly removed. A sharp pointed knife was again inserted through the incision and the "roof" of the abscess was incised to its periphery from which point the knife is passed in a circular manner removing completely the overlying brain cortex and capsule of the abscess, if one is present. Thus, the abscess cavity is completely "unroofed". The cut margin of the brain oozes only slightly and does not bleed as does the normal brain tissue when incised. This is probably due to the fact that most brain abscesses are due to retrograde thrombosis which cuts off the major part of the blood supply: at any rate the cut margin oozes but slightly.

For what Dr. Eagleton had said concerning the paper and the work which the paper represented, Dr. King said that he had no words to express his thanks. Considering the fact that Dr. Eagleton had had probably the greatest experience of any man in the United States with brain abscess and that his work had been highly commended and honored by otologists and physicians everywhere caused Dr. King to feel all the more appreciative, of Dr. Eagleton's remarks.

Dr. King stated that the herniation which occurred in the first case was accidental and although hernia cerebri had developed in this case, the patient recovered. The hernia was not intended: it was purely accidental. Other cases have been reported in which hernia cerebri developed and the patient recovered. The reason for the development or institution of the procedure as described in this paper was due to the fact that the case spoken of had recovered with herniation and dakinization, while two other cases subsequently operated upon with the old drainage methods without herniation, had died. Considering

the details of these cases, it was believed that the reason for the recovery of cases in which herniation occurs with eversion of the abscess cavity so that first, a secondary pocketing could not occur, second, compression was relieved and, third, the combatting of infection could be adequately carried out by use of Dakins solution.

Dr. King stated that he was aware that the group of cases reported was small and that the next patient operated on in this manner might die, but the fact remained that all four which he had operated upon consecutively by this method had recovered. In none of these cases had temperature become more elevated than 101 or 101½°. The postoperative course of these cases also was so different from cases treated according to other methods described in which the course was usually quite stormy, followed by death.

Dr. Herbert Smith, of Buffalo, after having seen the results in the second and third cases reported tonight, operated on two cases of brain abscess by this method. Both cases recovered.

Dr. Gordon Berry, of Worcester, Mass., had a case of cerebellar abscess under his observation which had been drained according to one of the other methods. The patient did well for a time, after which the symptoms became worse. He was acquainted with the procedure which I have described and decided to operate on this patient in this manner. He ligated the lateral sinus according to the method described by Dr. Eagleton, divided it and exposed the cerebellar lobe and allowed herniation to take place. The case did well following this procedure: in fact, the patient improved so much that she insisted upon getting out of bed and walking about. She was allowed to get out of bed, when she suddenly had a collapse and died. Had she stayed in bed and waited until firmer adhesions had formed about the site of operation it is believed that she might have recovered.

Dr. King stated that at any rate since these cases have done so well and the percentage of recovery being so much higher than with other procedures which have been carried out, he intends to continue operating upon cases of brain abscess in this manner, unless his results in the future prove that this procedure is not the proper one.

Problems in Otology and What Poland is Doing for Their Solution. Prof. John Sendiziak, M.D., Warsaw, Poland.

(*To appear in a subsequent issue of* THE LARYNGOSCOPE.)

SECTION ON LARYNGOLOGY AND RHINOLOGY.

May 28, 1924.

Syphilis of Larynx; Penchondritis. Dr. John Devereux Kernan, Jr.

B. J., age 30 years. History: Patient came to Manhattan Eye, Ear and Throat Hospital suffering from laryngeal obstruction, evidently due to a syphilitic perichondritis. He was put on mixed treatment and given salvarsan. There was a sudden increase of the laryngeal obstruction, which called for tracheotomy.

Summary to Feb. 22, 1924: Since tracheotomy the patient has had intense anti-syphilitic treatment. The structures about the mouth of the larynx have been cauterized and resected repeatedly. A number of pieces of the cricoid cartilage have been removed.

A laryngostomy was done, the larynx being split as extensively as possible and as much as possible of the redundant tissue removed. At present there seems to be sufficient opening through the larynx to allow a closure of the laryngostomy wound.

Feb. 28: Is ready for closure of laryngostomy wound.

Mar. 15: Operated at Bellevue. Skin about edges of laryngostomy wound inverted and sutured as lining, covered by shifting in skin from sides.

Mar. 20: Breathes freely through the larynx. Seems to be well.

Larynx, Diphtheritic Nerosis of Cartilages, Tracheotomy, Laryngectomy. Dr. John Devereux Kernan, Jr.

L. M., age 18 years. Admitted to Bellevue Hospital, Feb. 7, 1924; discharged Apr. 14, 1924.

Summary: Laryngostomy. Patient was tracheotomized at the age of two for diphtheria. Was first seen five years ago at the age of 13. He has been wearing the laryngostomy tube since it was first put in. The larynx was completely atropied with entire loss of voice. A laryngostomy done. The lumen of the larynx had disappeared completely, except for a passage about the size of a small probe. Since that operation the opening into the pharynx has been kept clear with rubber tubes. Many attempts have been made to dilate the passage to afford breathing space, but the scar tissue has been very obstinate. At the present time the patient has a good voice but the laryngostomy trench in the neck is still open. In order to deepen this trench cartilage has been planted along its borders longitudinally and across the upper end. An attempt now will be made to close over the opening.

Feb. 7, 1924: Operated at Bellevue. Cartilage placed about tracheal opening, one piece on each side, one piece at upper end.

Feb. 23: Closure of laryngostomy wound. Skin freed along edges of wound, turned in and sutured. Flaps drawn from each side and sutured over raw area in middle. Three small pieces of cartilages placed transversely.

Apr. 14: The wound all healed nicely. He has a small slit-like wound at lower end of laryngostomy. Passage through the larynx seems to be enlarging.

DISCUSSION:

DR. SAUL KNOPF: I wish to congratulate Dr. Kernan on the results of his laryngostomy cases. I had an opportunity to see both of these cases in the early stages, and it seems to me it was an almost hopeless situation. The young boy with the papilloma had so much of it, extending so far down underneath the cords and all around it, and even when he had the laryngostomy done, I thought he would never get rid of them. I was pleased to see the good results, particularly with regard to the closure of the laryngostomy wound. The same thing holds true of the other case presented. He had abscesses of the arytenoid cartilages, and a tremendous amount of inflammatory reaction, and the result there is remarkably good. He has a fairly nice open larynx.

DR. FRANCIS W. WHITE: I would like to know if the patient received any KI *before* the laryngostomy. In the second case, what was the source of the cartilage?

DR. JOHN D. KERNAN: Concerning the KI, I thought I brought it out particularly that intensive treatment, anti-syphilitic, was given him.

The source of the cartilage was the ribs. At the time I took the cartilage I was not prepared to put it into his trachea, but at that time I needed some cartilage for a nose, and so I took a bit of cartilage from his chest and used a part of it on a lady's nose, and subsequently for his larynx. It was implanted in his chest wall for about two years, and is surviving its second transplantation in his neck.

DR. FRANCIS W. WHITE: There are two points I wish to emphasize, first, that KI was administered *after* the laryngostomy, and, second, sometimes KI is given for inflammatory conditions in the larynx, it is run up in dosage, followed by edema and sudden death, so unless we are sure ample breathing space is present, it is not well to give KI.

DR. JOHN D. KERNAN: That is just the point about this man. He came into the clinic with a swelling in his larynx, and was given KI. Then when he got a sudden swelling of the larynx a hasty tracheotomy was called for. It is dangerous to give KI unless you are sure about the breathing space, because there may be a sudden swelling, followed by death, before anything can be done.

Papilloma of Larynx. Dr. John Devereux Kernan, Jr.

J. F., age 13 years. Came to Bellevue Hospital, Nov. 23, 1920, with history of ten months hoarseness and difficulty in breathing.

Examination showed larynx to be filled with multiple papilloma. In the course of the last four years the papilloma have been removed from the larynx fifteen times. He has had four treatments with radium. Three years ago growing obstruction called for a tracheotomy. The tracheotomy tube removed and wound closed one year ago.

At the present time the larynx is free of papilloma and voice is good.

J. R., age 34 years. Admitted to Bellevue Hospital, Nov. 13, 1923; discharged, Dec. 7, 1923.

About one year previous to admission during a paroxysm of coughing patient spit up a little blood. For a number of years his voice has been slightly husky. He was seen recently by a physician and advised to enter hospital for removal of papilloma of larynx. He recently noticed marked hoarseness. Synchronous with bad cold.

Special examination: Deviated septum to right. Deep furrows on left.

Larynx: Fibroma with broad base of attachment covering almost entire left cord on upper surface; interferes with mobility of cord.

Nov. 13, 1923, laryngoscopy, Dr. Kernan.

Large papilloma of left vocal cord involving anterior half removed. In doing this anterior half of cord was punched away. Tip of arytenoid swings into lumen of larynx on vocalization.

Nov. 14, 1923: Considerable swelling of all structures of larynx. Anterior portion of left vocal cord has been bitten away.

Dec. 5, 1923: Dr. C. G. Coakley; too early to do any further work upon larynx at present. Wait until completely healed over.

Pathological report: Source of specimen, left vocal cord.

Macroscopical examination: Specimen consists of a small piece of tissue.

Microscopical examination: Sections show a circumscribed mass covered with hypertrophied epithelium. The rest of the specimen is made up of rather edematous connective tissue.

Diagnosis: Fibroma.

Patient scoped weekly by Dr. Kernan.

Summary to date: Since discharge from hospital patient has had weekly application of silver nitrate to his larynx up to 20 per cent in strength. His voice has steadily improved until it is only slightly husky. At the present time the left vocal cord seems to be completely restored.

Case of Ahino-Scleroma of Larynx, Trachea and Bronchi. Dr. John Devereux Kernan, Jr.

A. S., age 22 years. Admitted to Bellevue Hospital, Oct. 24, 1923.

For two months previous to admission the patient has been very hoarse. Hoarseness came on suddenly. Coughs sometimes and occasionally brings up pieces of whitish cheesy material. Throat becomes very dry. Drinking hot fluids gives temporary relief. Has lost about 30 pounds since onset of present trouble. Unable to sleep. Can breathe fairly well during the day but at night has a tendency to choke. Considerable nasal discharge.

Special examination: Larynx, false cords anterior have grown together, covering all of the under structures. A very small opening is found posterior.

Laryngoscopy, Oct. 27, 1923, Dr. Symmers, Dr. Kernan.

There was partial fixation of both cords. Anterior of ventricular bands were adherent, forming an indefinite mass which obstructed one-third of the glottic opening. Several small bites made out of the mass. Satisfactory biting away of the tissue not accomplished. Following this a tracheotomy was done.

Summary to date: Following the tracheotomy repeated attempts were made to destroy the mass blocking the lumen of larynx with electric cautery, with the idea it was due to tuberculosis. The result of this treatment was that the patient got worse. Two months ago he began to have severe attacks of dyspnea, seemingly due to blocking of the tracheotomy tube. Removal of the tube and cleaning it did not however relieve him. Examination was then made of the trachea and

bronchus. Used a bronchoscopy through the trachea wound and considerable dried secretion was found on the wall of the trachea. It was crusts from this area which blocked the trachea tube. About one inch above bifurcation of trachea its lumen was constricted. The mouth of left bronchus was found greatly strictured, so that the opening with the lung was not more than a slit. The right bronchus was considerably strictured about one inch below bifurcation, but uniformly so that the lumen was round.

The patient has received injections of oil into trachea with idea in mind of keeping crust soft.

DISCUSSION:

DR. DAVID H. JONES: What form of oil was used, and in the papilloma case, was any sort of mixed treatment given?

DR. MERVIN C. MEYERSON: I should like to ask whether Dr. Kernan took into account the nasal condition of this patient. There is such a thing as a crusting of the trachea and bronchi co-existent with a chronic rhinitis, of a certain type. I saw a patient with that type of dyspnea recently, and the only treatment we have given her since the bronchoscopy was oil instillation. In that particular case it was a lady fifty or fifty-one years old, and we thought the condition was probably secondary to her nasal condition.

DR. JOHN D. KERNAN: The oil used was sterile olive oil. Any kind of oil, so long as it is sterile, will serve the purpose.

I did consider whether this condition was not secondary to a rhinitis sicca, but I thought not, because there did not seem to be enough in the nose to account for the very severe condition of the larynx. I never saw a rhinitis sicca followed by a complete closing-up of the larynx, as in this man, and in addition the threatened closure of the trachea and bronchi, so I hardly think it is secondary to a rhinitis sicca.

Double Abductor Paralysis of Vocal Cords. Dr. John Devereux Kernan, Jr.

J. H., age 40 years. Admitted to Bellevue Hospital, May 23, 1922; discharged, Aug. 15, 1922.

C. C. Difficulty in breathing, hoarseness, cough.

Onset suddenly one week previous to December 9, 1920. Duration, one week.

Course: Patient unable to sleep because of smothering feeling.

Special examination: Hyper. Left middle turbinate general congestion. Deviated septum.

Larynx: Showed general congestion. Small amount of swelling of arytenoids, cords thickened and do not adduct. Great swelling of ventricular bands which bulge out over cords. Cords very close together and only move slightly on inspiration.

Diagnosis: Bilateral aduction paralysis.

Physical examination: Negative, except for anemia.

Dec. 10, 1920: Blood Wassermann, negative. Dec. 13: Spinal Wassermann, negative. Dec. 16: Spinal tap, normal. X-ray, chest: pleural, adhesions at right base and thickened pleura of right lung. No infiltration of lung. Cardia, normal.

Summary of history on discharge: Soon after admission increased dyspnea called for a tracheotomy. One month after tracheotomy the left vocal cord was punched away together with underlying tissue. Two weeks after this the right vocal cord was removed. Patient discharged from hospital still wearing a tracheotomy tube. One year after removal of vocal cords the tracheotomy tube was removed and tracheotomy wound closed.

Examination: At present shows the patient has sufficient breathing space and adventitious vocal cords, which can be approximately on vocalization, enabling him to talk. The elasticity of the tissues pulls the cords apart when he makes no effort at vocalization. There is no true abduction.

DISCUSSION:

DR. CHARLES J. IMPERATORI: I recall seeing this patient several years ago, when I was attached to the service at Bellevue Hospital. A similar case presented at the New York Post-Graduate Hospital a year ago. This patient had had a goiter operation done some years previously at the Mayo Clinic. There was a double abductor paralysis and it was my intention to do a cordectomy after the method of Jackson, but without a preliminary tracheotomy. The patient was in the suspension laryngoscope; I incised one cord and that was all that was done. There was some bleeding—not so very profuse—and the patient stopped breathing. Assisted by good friends and associates, Dr. M. Jones and Dr. Perrault, artificial respiration was started, but to no avail. The patient had passed on. In insisted on an autopsy, for I felt that the patient had not died from hemorrhage. The autopsy revealed an anomalous blood vessel located immediately beneath the cord. It was 2 m.m. in diameter. There was no blood in the trachea or the chest. Whether this was the cause of death, or whether it was primary shock that occurred, or some inhibitory influence, I do not know. However, the patient died, and very quickly. This is a very distressing thing to have happen, and the thing that impressed me is that in no case should one attempt to do a cordectomy for a double abductor paralysis without a preliminary tracheotomy.

Dr. JAMES W. BABCOCK: I wonder if a division of the recurrent laryngeal nerves would not induce a complete paralysis which ought to relieve the dyspnea. I have never seen it tried, but I think it would be less laborious than a cordectomy.

DR. JOHN D. KERNAN: I think Dr. Imperatori is perfectly right about the tracheotomy. I should not dream of touching one of these cases without a tracheotomy. That is the first thing to do to relieve the dyspnea, and then you can go about taking care of the obstruction to the larynx. As to cutting the nerves, I did that in one case, and it was not very successful. The relaxation of the vocal cords was not sufficient to give him a breathing space. Subsequently I also resected the vocal cords, but not very deeply, and between the cutting of the nerves and the resection of the vocal cords, he had sufficient breathing space. One bad thing about cutting the nerves is that you destroy the adduction, and do not get any voice. If you can get space enough to breathe through, if there is a little adduction left, you can get some kind of a voice.

Metastatic Hypernephronia of the Nasal Septum and Accessory Sinuses.
Dr. Richard Travis Atkins.

S. W., male, white, age 34 years; sheet metal worker. Entered Bellevue Hospital, Dr. Coakley's service, May 31, 1918, with a history of increasing hoarseness, dyspnea and difficulty in swallowing, of seven months duration.

Laryngoscopic examination showed marked narrowing of the glottis, due to infiltration and edema, especially of the arytenoids. Wassermann, negative; chest, negative.

A tracheotomy was performed, which relieved the dyspnea, but the laryngeal swelling did not subside. Later a section was taken for microscopical examination and reported as follows: Section shows a small mass of tissue surrounded on the outer surface with mucous membrane. Beneath the mucous membrane the tissue consists of a rather loosely woven mass of connective tissue. In some places this tissue is hemorrhagic. Diagnosis: fibroid polyp. Dr. McWhorter.

Examination of nose showed a mild atrophic rhinitis with considerable crusting. The right antrum was dark on transillumination, but antrum puncture was negative.

The patient left the hospital some time later, much improved in general physical condition, but still wearing the tracheotomy tube.

On Mar. 26, 1924 (six years after first admission), the patient returned to the hospital complaining of marked nasal obstruction and

right frontal headache. He had continued to wear the tracheotomy tube but kept the opening corked most of the time.

The nasal obstruction began about two months before the second admission and is especially marked on the right side.

Examination of the nose shows the following: Right side: mucoid secretion. There is a large mass of fat-like friable tissue which completely fills the fossa and bleeds profusely when touched. It is attached to the septum and extends laterally to the ethmoidal region.

Left side: Crusty secretion. Mucous membrane atrophic. Middle turbinate much swollen and edematous.

General physical examination, negative.

Wassermann, negative.

A course of neosalvarsan was given with no change in the condition.

X-ray of chest: normal findings.

A section of the growth was removed for microscopical examination and reported by Dr. Douglas Symmers as follows:

Microscopic examination shows the presence of a vascularized connective tissue stroma, arranged in coarsely reticulated fashion, the interstices containing numbers of large, clear cells, which are finely reticulated and which bear a close morphological resemblance to the cells of the suprarenal capsule. The histology of the growth, as far as I can determine is indistinguishable from that of certain forms of hypernephroma and the possibility of its metastatic nature must be borne in mind. On the other hand, it is possible that the process may represent a chronic productive inflammatory lesion and that the large clear cells are embryonal fat cells. Inflammatory lesions of this description are well known in other parts of the body, but I have never seen one in which the arrangement of the cells at all resemble the lesion under consideration. Rhino-scleroma is a possibility, but not, I think, a probability. Unfortunately there is no tissue left which is available for staining for the bacillus of rhino-scleroma. In the circumstances I am quite unprepared to make a positive diagnosis.

Tentative diagnosis: Metastatic hypernephroma of nasal septum. (Signed) Dr. Douglas Symmers.

Further microscopic examination shows precisely the same histological changes as those previously reported. In addition sections were specially stained for the bacillus of rhino-scleroma, but none were found.

Tentative diagnosis: Metastatic hypernephroma. (Signed) Dr. Douglas Symmers.

X-ray of the nasal accessory sinuses shows the following:

The frontal sinuses are multilocular-symmetrical marked diminution of the illumination of the left frontal.

The ethmoids are of even size—the left is normally illuminated; right shows marked diminution of the illumination.

The maxillary sinuses are of even size; there is marked diminution of the illumination of the right maxillary sinus. The left maxillary sinus also shows slight diminution of the illumination.

The right nasal cavity is entirely filled with a mass which produces a pressure erosion of the floor of the nasal fossa. The nasal wall of the antrum is not perforated but is markedly atrophic. The orbital wall is not perforated.

X-ray of the kidneys:

Opaque catheter in right ureter reaches the level of the transverse process of the first lumbar, and is of usual position.

No evidence of calculus along its course.

Lower pale of the right kidney is one inch above the level of the transverse process of the third lumbar and appears to be of small size and usual contour.

No opaque mixture present.

Lower pole of the left kidney is twelve inches below the level of the transverse process of the third lumbar. Its upper pole is one inch above the transverse process of the first.

The kidney is of moderate size and usual contour.

I am showing this patient because of the rarity of the growth which he presents. There is a record of but one similar case in the literature, that I am aware of, and that case was reported by Dr. H. Arrowsmith, at a meeting of this Section Dec. 10, 1915. Dr. Arrowsmith removed the growth after ligation of the external carotid, by a lateral rhinotomy. The bleeding was very profuse and the patient died a few hours later.

DISCUSSION:

DR. DOUGLAS SYMMERS: I had the opportunity to examine the tissue removed from the nose in the case described by Dr. Atkins, and the structure was that of a typical hypernephroma, although the patient presented no symptoms or physical signs of a tumor in the region of the suprarenal capsules or kidneys. However, every now and then the pathologist encounters such a case. For example, very small carcinomata arising in the thyroid gland may metastasize the bony system to an enormous extent. So, too, with the hypernephroma. Such a tumor, the size, say, of one's thumb nail, imbedded in the substance of the kidney, may metastasize widely, not only to the bony system, but elsewhere, without at the same time giving rise to any clinically detectable signs referrable to the abdomen. In this connection, I might point out that the suprarenal capsule is the seat of certain pathological changes which are of interest to those of you whose work is confined largely to the cephalic extremity. I refer to the fact that the suprarenal capsule has a dual embryogenesis and that, in the lower forms, it represents two organs which are separate one from the other, not only anatomically, but functionally. In the higher forms, on the other hand, the suprarenal capsule is a fused organ. The medulla, which is derived from the neuro-ectoderm, is capable of giving rise to a tumor known as the neuroblastoma. Perhaps the most interesting feature of this growth is that its metastases not infrequently occur in the parietal bone, usually on one side, and are associated with ecchymosis of the adjacent tissues and unilateral exophthalmos. The hypernephroma, which is composed of cells morphologically identical with those of the suprarenal cortex, likewise has a tendency to metastasize to bones, as is exemplified by Dr. Atkins' case. This, however, is the only opportunity that I have had to note the presence of metastatic deposits in this particular situation.

DR. FRANCIS W. WHITE: I should like to ask in the small number of cases reported if there is any special predilection for sex.

DR. DOUGLAS SYMMERS: Not that I know of.

A Case of Osteoma of the Frontal Sinus. Dr. James W. Babcock.

Mr. John S., age 30 years, white, native of the United States, motor mechanic, was admitted to Dr. Coakley's service at Bellevue Hospital, Nov. 13, 1923, with a history of severe throbbing frontal headaches for four days out of each week, apparenty not influenced by habits or general health and never helped by treatment. He fell, striking his head, and was unconscious for several hours two years before the onset. He was infected with lues in 1916 and was treated until 1918, when he showed three negative Wassermanns. His mental history is interesting. He had felt a sense of inferiority and had changed his work frequently. He had also indulged in useless lying and odd compulsive acts for the past eighteen years. No real psychosis could be determined and Dr. H. S. Wolff considers the condition a personality defect. He had a negative Wassermann on his spinal fluid but a positive blood Wassermann. He was given intensive antiluetic treatment for six weeks without effect on his symptoms or change in the X-ray findings which showed an opaque bony mass apparently to the left of the inter-frontal septum, 1½ by 3 c.m. There was no evidence of inflammation of the sinuses except that the left frontal did not illuminate as well as the right.

An operation was performed on Dec. 29, 1923, the left frontal sinus being exenterated by Dr. Coakley's modification of the Killian operation. The ethmoids were undisturbed except for the passage of a drain through the nose. A spongy bony tumor was found to replace the inter-frontal

septum and it extended down the vertical plate of the ethmoid for one-half centimeter, the membrane of the sinus being normal. During the operation the almost unavoidable accident of opening the right frontal sinus through the septum occurred. The wound healed by primary union, but a week after the operation there was edema in the midline and headache. Exploration showed an infection of the right frontal sinus which drained through the opening in the inter-frontal septum for a few days, and after ineffectually trying to treat it as one would a simple frontal sinusitis by intranasal drainage and irrigation, a second operation was performed on the right frontal sinus similar to that on the left. This was done on Jan. 29, 1924, by Dr. Wilkerson. This was healed nicely by Feb. 2, 1924, but by this time he had both his maxillary sinuses infected. These cleared up by intranasal treatment and he now seems well, headaches gone and mental condition improved.

The pathological report was as follows: "Sections from the small pieces of tissue from the septum in the frontal sinus show a dense mass of connective tissue in which are many small spicula of bone. Diagnosis: Dense connective tissue and bone. Sections of the specimen from the right frontal sinus show rather dense connective tissue infiltrated with hemorrhage and leucocytes, most of which are polynuclears. Diagnosis: Acute inflammation.

This leaves the diagnosis somewhat in doubt. It was evidently not a true osteoma, but was it the remains of a hematoma from the fall two years before the onset of the spmptoms or was it from a gumma with the primary lesion ten years after the onset of the symptoms? At all events, the case shows the disastrous effects of opening one frontal sinus while operating upon the other even when that one seems uninfected.

DISCUSSION:

DR. CHARLES J. IMPERATORI: In this type of operation, the frontal sinus is completely obliterated, and while the cosmetic results are poor in profile, it is my opinion the proper type of operation for this condition. Head-on, the disfigurement is not so noticeable, but in profile it is distinctly so. However, shall it be a disfiguring operation, or shall the patient have recurring attacks of frontal sinusitis. To my mind, it is better that the patient be entirely cured, rather than consider the cosmetic results. If this type of operation is not done, the first head cold will usually start up a recurrence of the sinus condition, undoubtedly due to a dead space left in the healing. In this method, that is, the modified Killian operation, that Dr. Coakley has done so many times, the results depend first on the thoroughness of the operation and, secondly, on the after-treatment. I think that Dr. Babcock might dilate a little on the post-operative treatment.

DR. JAMES W. BABCOCK: The after-treatment is extremely simple. You keep firm pressure and obliterate the sinus. They must be very carefully dressed with small squares of gauze wet in salin, so that the skin and periosteum are kept in firm contact with the inner table, and there is no dead space. If you permit dead space, or the patient attempts to blow the nose before it is firmly fixed, you will always have trouble. If you see that there is a minimal amount of pus formation, the patient will get along very well. If you fuss too much with these cases, there is trouble.

Lymphangioma of the Pharynx and Larynx. Dr. A. J. Huey.

(*To be published in a subsequent issue of* THE LARYNGOSCOPE.)

DISCUSSION:

DR. ALEXANDER FRASER: I have not much to say in the way of discussion. In the first place, all the sections of this tumor that I have looked at show that the general background is typical tonsillar tissues, covered with typical squamous epithelium, and with very much dilated crypts. The lesion in this tissue is what is usually called a lymphangioma, but it is not a true neoplasm. It is simply a dilatation of the lymph vessels, what we call the cavernous type. In the first specimen there

was no trauma and there was no blood in these caverns, so that is good evidence that it is a lymphangioma, and not an hemangioma. In the second specimen, many of the caverns are filled with blood, but as it was white before it was injured, that is secondary evidence that it is a lymphangioma and not an hemangioma. There was no evidence of laryngeal tissue so far as I could see. It is probably ectopic tonsillar tissue, which is very rare indeed. So when you have a tube which embryologically divides, the esophagus and the other differentiation into the respiratory tract, for example, and where we have a differentiation in function and position, we are liable to get misplacements of the tissue. Take the region of the tonsil; there is an embryonic pouch perforated by lymphoid tissue containing a large number of lymphatic vessels, so we can understand here such an embryonic misplacement. Why this did not develop into a true tumor earlier is an interesting fact. Sometimes we get these so-called lymphangiomata from acquired causes, as from elephantiasis. This case then is one of misplaced tonsillar tissue. As regards the frequency of them, Phillips and Ruhr collected twenty-six cases. They called them simply angioma. They were partially in the thorax, and partially in the larynx. It is difficult to say whether the angioma was a lymphangioma or an hemangioma, because as in this case, we are liable to have hemorrhage into the lymph cavities. Their detailed explanation is such that I cannot tell whether it was tonsillar tissue, or what the background of the tumor was. Let me say in conclusion that this is not a true tumor; it is a congenital misplacement of tissue which is liable to occur at this situation, just as we have such things in congenital heart disease.

DR. JOHN MARION LORE: This case is of especial interest to the Manhattan Hospital, because we have a man with a large tumor mass in the throat, apparently arising from the tonsil. I should like to ask just the technique Dr. Huey used in getting the large mass out of the throat. This man had to have an emergency tracheotomy done because the mass became swollen through some trauma. I have taken eight or nine sections of that, and I have not had a report that would give us a diagnosis.

DR. ARTHUR J. HUEY: With the wire I was unsuccessful. After giving an anesthetic through the tracheal tube, I started at the tip of the tumor with a long pair of scissors and dissected down as far as I could go; then after that put in a large laryngoscope. We have one with a diameter of 1½ inches, open at the side. I was able to get this in front of the mass, and working with the forceps and the long handled scissors, I dissected free the remainder of the growth. There was very little bleeding in this case.

DR. LEON T. LEWALD: At the request of Dr. Huey I made a Roentgenological examination in order to determine the extent of the growth in the phaynx and larynx. This appeared to be particularly important in view of the fact that the tumor almost completely occluded the pharynx and upper portion of the larynx. Dr. Huey informed me that he was unable to determine the lower limit of the tumor because it was impossible to pass an instrument beyond the mass. Having previously outlined the limits of a retropharyngeal abscess in a case referred to me by Dr. J. F. Bell, of Englewood, N. J., I felt confident it would be possible to determine the exact size of the mass on account of the surrounding air in the trachea.

After removal of the growth a radiograph was made for comparison with the appearance before operation

Acute Lymphatic Leukemia. Simulating Peritonsillar Abscess. A Report of Two Cases. Dr. Richard Travis Atkins.

G. W., male, colored, age 52 years, U. S. Entered Bellevue Hospital, Dr. Coakley's service, Jan. 23, 1924, with a history of sore throat of one week's duration, and swelling in the left side of neck. On admission, temperature, 98.4°; pulse, 100; respiration, 24.

General physical examination: Ichthyotic condition covering entire body. Abdomen tense. Enlargement of liver and spleen. Nose, nega-

tive. Throat and neck: The lymphatic glands at the angle of the left lower jaw are swollen and tender, with a fluctuating tumor underneath. Patient is unable to open the mouth more than one-half inch. Tongue is coated with a heavy brownish fur and the breath is very foul. Fauces filled with thick mucus. Redness and edema of soft palate and uvula, with marked swelling and induration of both tonsils, more marked on the left side. Incision revealed hard, indurated, friable tissue and no pus.

Unfortunately the patient died suddenly before a blood examination was made.

Autopsy, however, revealed the true nature of the disease and the following is a detailed report of the pathologist's findings:

Post-mortem record: G. W., age 52 years; died, Jan, 24, 1924. Date of autopsy, Jan. 25, 1924; pathologist, Dr. Gonzales and Dr. Symmers.

Heart: Extensive replacement fibrosis of left auricle and ventricle with aneurysm formation.

Lungs: Emphysema.

Spleen: Splenomegaly, lymphoid hyperplasia.

Kidneys: Partial aplasia (left), focal lymphomata (right).

Liver: Focal lyphomata.

Testicles: Chronic interstitial orchitis (left), lymphoid infiltration of right testicle (?).

Aorta: Calcified dissecting aneurysm of abdominal aorta.

Lymph nodes: Marked hyperplasia of cervical, axillary, peri-pancreatic peri-aortic, inguinal and femoral lymph nodes (lymphatic leukemia).

Tongue: Cangrenous ulcer (gumma?).

The body is that of a negro man, 52 years of age, 168 c.m. in length, of slender, well developed frame, poor musculature and nutrition. The skin of the entire body is roughened, thickened and somewhat scaly, presenting through the scales a faint suggestion of reddish discoloration. There are considerable numbers of enlarged, firm, discrete lymph nodes to be felt in the neck and both axillae, while in the femoral region of both sides are large, egg-shaped, nodular masses, measuring fully 5 c.m. in length.

On section, subcutaneous fat and muscle tissue are poorly preserved. The peritoneum is smooth and glistening throughout, the diaphragm normally placed.

Chest: No thymic remains are visible. The peri-tracheal lymph nodes do not appear to be enlarged. Both pleural cavities are dry and free from adhesions.

Lungs: Are voluminous, pale and pit on pressure. On section, they are slightly congested and distinctly emphysematous, but otherwise well preserved. The peribronchial lymph nodes are unchanged.

Heart: The pericardium is smooth and glistening. The heart is about normal in size. Both auriculo-ventricular openings are freely permeable. The endocardium on the right side is excellently well preserved. The pulmonary artery presents a faintly yellowish appearance, but is apparently otherwise unchanged. The left auriculo-ventricular opening is likewise easily permeable and the mitral valves appear to be well preserved. Back of the posterior mitral leaflet, corresponding to the junction of auricle and ventricle, is a pouch-like dilation which appears about 5 c.m. in length and 2½ c.m. in breadth. The heart muscle corresponding to this pouch is almost completely replaced by white, glistening, firm fibrous tissue and similar streaks and bands of fibrous tissue run down the wall of the left ventricle as far as the apex. The chordae tendineae are markedly sclerotic. The aorta valves are unchanged. The aorta presents a few yellowish and whitish streaks without bands of calcification.

Spleen: Weighs 480 gms. and measures 12x6 c.m. Seen through the capsule it presents a light slate blue color. On section, the organ cuts readily. The cut surface is perfectly smooth and scattered over it are innumerable pin-head sized or larger, dirty whitish or faintly cream colored, ill-defined splotch-like bodies, corresponding apparently to lymphoid collections. The pulp is fairly abundant and of fairly firm consistance.

Kidneys: The left kidney is decidedly diminished in size. On section it cuts rather firmly. At about the center of the organ is a crypt-like depression and the substance of the kidney, on section above this line of depression appears to be slightly firmer than that below where the markings are distinct and cortex and medulla are well proportioned.

The right kidney is considerably larger than in normal circumstances. On section it cuts readily. The capsule stripe with ease and leaves behind a perfectly smooth surface. Cortex and medulla are well proportioned. The cortical markings are distinct. The substance of the kidney presents one or two large splotch-like areas, which are faintly opaque and pinkish in color. Scattered through the parenchym are numbers of very minute whitish specks.

Pancreas: On section the pancreas appears to be well preserved. Above the pancreas are 15 or 20 discrete, moderately firm lymph nodes, varying in size from ½ to 3 c.m. On section they present a perfectly smooth, faintly cream colored surface. The lymph nodes around the aorta as far downward as the brim of the pelvis are enlarged to the extent of 40 or 50 and in size and appearance are the same as those around the pancreas.

Liver: Is markedly increased in size. Through the capsule it can be seen that the substance of the organ is liberally sprinkled over with whitish specks and on section these whitish or grayish specks are scattered through the cut surface literally by myriads. Otherwise the liver presents no noteworthy naked eye changes.

Stomach, intestines, esophagus: Are well preserved although lying by the side of the esophagus in the mid-thoracic region are two or three lymph nodes which are much the same as those described elsewhere.

Bladder and prostate: Apparently unchanged.

Testicles: The left testicle is markedly diminished in size. Firm in consistence and on section the cut surface is smooth, whitish or grayish white in color and the substance is firm in consistence. The right testicle is brownish in color and feels rather firm to the touch.

Aorta: The thoracic aorta is well preserved. The abdominal aorta, however, just above the bifurcation, presents a conical calcified mass, which almost occludes the lumen of the vessel, but just to the left side of the mass is a dissecting aneurysm through which the blood flow during life must have been preceded.

Bones: The bone marrow of the vertebrae is light pinkish in color; that of the ribs is reddish.

Organs of the neck: On removal of the structures of the neck it is found that the base of the tongue presents a large discolored gangranous, softened area which occupies the whole of that part of the tongue lying between the circumvellate papiliae and the base of the epiglottis. The arytenoid folds in the larynx are markedly rounded, swollen, cream colored and apparently richly infiltrated by lymphoid tissue. The rest of the larynx and trachea are apparently well preserved. The thyroid shows no noteworthy changes.

Lymph nodes: The lymph nodes in the neck are enlarged on both sides to the number of 60 or 70, the individual nodes being discrete, yellowish or cream colored and presenting on section, much the same appearance as those described elsewhere. The axillary lymph nodes are not distorted. The inguinal and femoral lymph nodes are markedly enlarged and are present to the number of 70-80 on each side. On section they present the same appearance as those in other parts of the body.

Microscopical diagnosis: Lymphatic leukemia, with infiltration of lymph nodes, spleen, liver and testes.—Dr. Richter.

H. S., female, aged 30 years, U. S. Referred to me by Dr. Nancy Jenison, Feb. 13, 1924.

Patient gave a history of sore throat accompanied by swelling of the right side of the neck, of ten days' duration. This entirely subsided and the left side became swollen. There was some difficulty in swallowing and breathing. The temperature was never above 100.4° F. Examination of the throat showed considerable swelling and edema of the soft palate, uvula and pillars of the fauces. The left tonsil was also

swollen and there was a thick, greenish exudate on its surface at the upper pole which was due to a growth of streptococci. There was edema of the left half of the epiglottis and the ary-epiglottic fold. Several hard, distinct and slightly tender lymphatic glands were palpable in the posterior triangle on the left side.

General examination: Palpable spleen. Enlargement of axillary and inguinal glands. Incision of the peritonsillar swelling showed no pus; the tissue was indurated and friable and the wound gaped.

The patient was removed to the New York Eye and Ear Infirmary, where a blood examination was made and the following is the pathologists' report: Hemoglobin, 65 per cent; red blood cells, 2,640,000; red blood cells, 52 per cent; white blood cells, 134,000; color index, 1 per cent plus; small mononuclears, 21 per cent; large mononuclears, 77 per cent; polymorphonuclears, 2 per cent.—E. B. Burchell.

The faucial swelling gradually increased in size, swallowing became very difficult, respiration labored and the patient died, one month after the onset of the disease. There was no autopsy.

DISCUSSION:

DR. LOUIS HUBERT: About a year and a half ago, we had a case of lymphatic leukemia in which we were much interested. This patient, however, when first seen, had no enlargement of the spleen or any other sign that would indicate a blood disease; he was not even anemic. His only difficulty was dyspnea on exertion. He had been examined by a number of physicians and told that his heart, lungs and abdominal organs were normal, and he was advised to see a laryngologist. When I saw him, everything was practically negative, but when the larynx was examined, I found, below the vocal cords, two large masses, dark purplish in color, uniformly smooth, and practically in contact, so that there was very little breathing space. There was only a small fissure between the two masses. Within a few days he developed acute dyspnea, and Dr. White and I did a tracheotomy under local anesthesia. He was breathing pretty well after that. The blood was examined, and showed 90 per cent large lymphocytes. At that time he developed glandular enlargement in the neck, the axilla, the groin, and the epitrochlear region, and also a macular eruption, similar to a roseola, so we thought he had syphilis. He had some salvarsan given, although the Wassermann was negative. After he had been in the hospital about a week, we decided to give him X-ray treatment. This was done at the Lenox Hill Dispensary. The swelling of the larynx got smaller so that he could breathe more easily, even when the opening of the tracheotomy tube was closed. After a week or so he complained that he felt a weight in his abdomen, and examination revealed for the first time a large spleen. His ankles and feet became swollen. He became very weak, and was admitted to the Lenox Hill Hospital for regular X-ray treatment. In the beginning the treatment did him some good. The swelling of his ankles and feet disappeared; he felt generally much better, and the edema below the vocal cords was practically dissolved by the X-ray. Afterwards he became worse, and died. The important thing is that when he first presented himself there was nothing to make us think of such a serious disease; he was well and strong, and the only thing he complained of was dyspnea on exertion, and the only thing we found was a subglottic edema.

A Case of Carcinoma of the Maxillary Sinus with Peculiar Cervical Lymphadenitis.

Mr. James C., age 39 years, white, native of the United States, salesman, was admitted to Dr. Coakley's service at Bellevue Hospital, Apr. 27, 1923, with a history of obstruction of the right nares for a year and several intranasal operations without relief and with severe bleeding. There had been some nasal discharge for the past five months, growing more purulent. There had been slight headache for several months, but for the past month there had been severe pain over the whole right side of the head every afternoon. Since November, 1922, there had been enlarged left cervical lymph nodes which were incised on becoming

acutely inflamed, in January, 1923. Adenoids were removed at the same time. The wound healed promptly. Enlarged lymph nodes on the right side of the neck had been noted in the past two weeks.

The right nares was filled with a cauliflower-like mass apparently springing from the lateral wall, and a specimen removed showed epithelioma. Radiograph showed a cloudiness of the right antrum and ethmoid and apparent erosion of the orbital plate. Both sides of the neck showed very hard, moderately large lymph nodes extending from behind the angle of the jaw to the clavicle, with an adherent scar behind the upper third of the left sterno-mastoid. Otherwise the physical examination was negative.

An operation was performed on Apr. 28, 1923, at which the tumor was removed, but only the right side of the neck was dissected as this proved a very long and difficult procedure. An incision was made along the anterior border of the sterno-mastoid. Superficial and deep fascia were deviated by blunt and sharp dissection until the glands were encountered. The glands were removed by blunt and sharp dissection. In attempting to remove a mass of glands at the angle of the mandible the internal jugular vein was ruptured and finally ligated with much difficulty. The external carotid was next ligated. Two rubber drains were inserted and the wound closed in two layers, fascia with catgut and skin with silkworm gut. Next a postnasal plug was inserted and the right side of the face and forehead prepared. An incision was made midway between the inner canthus of the eye and the dorsum of the nose beginning one-fourth inch posterior to the supra-orbital notch and ending at the inferior border of the nasal bone. This incision was later extended downward to and into the right nares so that the right ala of the nose could be retracted upward and to the left. The nasal process of the maxillary bone was removed with chisel and mallet and the ethmoid cells were broken into and removed. The anterior wall of the sphenoid was removed and also the medial wall of the antrum as most of it was necrotic and broken down. The antrum was freed of the tumor masses with curette and Bruning forceps. The antrum and nares were packed with vaseline gauze and the wound closed with silkworm gut. The patient left the operating room in good condition.

The patient made an unexpectedly good recovery and the wounds healed by primary union. It was obvious, however, that the lymph nodes near the jugular bulb were left and that the growth in the antrum must extend beyond the field of operation.

We were surprised and gratified to learn from the pathological report that the lymph nodes from the neck showed no evidence of metastases, although we had a second careful search in which Dr. Symmers concurred. Microscopic examination of the specimens was reported as follows: "Sections taken from the glands show mostly a mass of very dense scar tissue which is profusely infiltrated with round cells. The lymph nodes show a marked hyperplasia of the lymphoid tissue. Sections from the ethmoid show dense connective tissue profusely infiltrated with epithelial cells. These cells show a highly chromatic nucleus and many mitotic figures. Diagnosis: Epithelioma of ethmoid, scar tissue, hyperplastic lymphoid tissue."

The patient was discharged on May 11, 1923, to have radio-therapy, but returned two days later with much redness, swelling and induration on the left side of the neck. This increased and resembled Ludwig's angina by the next day. It was incised under local anesthesia, thin gray pus being found in the submaxillary region and posteriorly under the trapezius. After incision these symptoms subsided and the wounds healed promptly.

He received considerable radio-therapy and for six months seemed in good condition, the left cervical lymph nodes even being smaller. The interior of his right antrum showed no evidence of recurrence, although he did have crusting in his right nares, which could be controlled by cleanliness. Six months ago he showed a small nodule in the scar to the right of his ala, which was excised under local anesthesia with a strand of tissue under it resembling and proving to be epitheli-

oma. This wound healed promptly and additional efforts with radiotherapy were urged. He has, however, gone down hill since. There have been attacks of "fainting" suspicious of intracranial involvement, paralysis of the left vocal chord, and severe pain in the left shoulder and arm coming from pressure on the roots of the brachial plexus by nodes which are stony hard and which seem undoubtedly metastases in spite of the report on the nodes from the right side. No further operative measures seemed to be justified and we have only tried to keep him comfortable.

Removal of Tonsils and Secondary Anemia. Dr. J. W. Fowlkes.

This is a history of a male patient, 23 years of age, who entered Bellevue Hospital Feb. 19, of this year. He was complaining of weakness and marked dyspnea, which he had had for five months, becoming more pronounced in the last four weeks.

His past history is negative, except an attack resembling this, one a year ago, which cleared up in a short time.

On physical examination there was moderate emaciation, marked pallow and petechial spots on the neck, and a small hemorrhage in the retina of one eye. Other than this the physical examination was negative.

The urine, blood and feces were immediately examined, all found to be normal except the blood. The blood was a picture of marked secondary anemia. There were only 584,000 reds and 3,400 white cells, of which 47 per cent were P.M.Ns. and 53 per cent lymphocytes. The hemoglobin at this time was 20 per cent. There was no change in the morphology.

He was transfused ten times, using 700 to 800 c.c. of blood each time. These transfusions brought the count up to a little over 1,000,000 each time, which never remained up over one week, then going down to the count of before, and hemoglobin decreasing accordingly.

Cultures from his tonsils were then made; these showed streptococcus hemolyticus with a hemolytic power stronger than any of the stock cultures, proved by titration with very dilute solutions.

After squeezing the tonsils for cultures, each time the temperature would go up and the petechial spots would appear. He also has has had three attacks of tonsilitis from February until Apr. 1.

Since his coagulation time had been 15 minutes, we decided to remove only one tonsil. This was done on Apr. 21. The coagulation time had been reduced to 7 minutes by administering calcium lactate over a period of one week. His temperature was 101° the day after the operation, just as it had been after squeezing the tonsils, and the petechial spots also appeared.

After 24 hours he began to bleed but not profusely; this continued for 24 hours, being stopped at intervals by holding a sponge in the fossae. The bleeding was on oozing from an upper pole. After the third day he began to improve and has continued ever since.

On May 2, eleven days after the operation, his red count was 2,300,000, then he was transfused again, and on May 19 his red count was 2,800,000 with hemoglobin 62 per cent. This shows a steady increase of the red cells after the last transfusion, whereas before the operation the cells would return to the former count in a week's time.

Up to the time of the operation many blood cultures had been taken, all of which were sterile. Two weeks after operation a blood culture was positive, showing streptococcus, a type which did not hemolize blood as fast as the cultures from his tonsils.

Five days ago I removed the second tonsil. The bleeding was quite profuse, much more than at the time of the first operation.

He continued to ooze during the first night and part of the next day. There has been no bleeding since and he is now in very good condition. The day after the operation his temperature was 101°, but went down to normal the second day.

This case is especially interesting for several reasons: First, a markedly secondary anemia due to tonsillar infection; second, the surgical risk involved with this blood picture.

NASHVILLE ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY.

The Nashville Academy of Ophthalmology and Oto-Laryngology met at St. Thomas Hospital, April 21, 1924, with the President, Dr. E. B. Cayce, in the chair. The following cases were brought before the Society:

Mastoidectomy with Closure by the Bloodclot Method. Dr. Hilliard Wood.

Dr. Hilliard Wood presented the case of B. O., aged 6, who was first seen by him on March 6, 1924.

History: February 12, 1924 had cold, influenza, and pain in the right ear. Has had some tonsillitis.

February 20, right ear began to discharge and has continued to discharge to March 4, when discharge stopped and patient had a chill at 11 P. M., followed by high fever.

March 5, 3 P. M., had convulsion for five minutes. At 12 o'clock following noon, had chill and temperature 104.4° and pulse 130. Ear running.

Patient entered St. Thomas Hospital 10 P. M.

Examination: (Feb. 6, 1924.) Right ear, slight pus discharge. No marked swelling about canal. Drum not bulging but white. No perforation seen by Valsalva's inflation. Moderate tenderness over antrum. No redness. Slight, if any, displacement of auricle.

Chest negative. Urine normal. White blood count 15,000.

X-ray of mastoids by Drs. King and Hamilton shows right mastoid cloudy. Left mastoid well developed and normal.

Enlarged faucial and third tonsils.

Diagnosis: Diseased faucial and third tonsils.

Right ear, acute suppurative otitis media, with acute mastoiditis. Advised mastoid operation and removal of faucial and third tonsils.

March 7: Operation at St. Thomas Hospital. Did simple mastoidectomy on right side. Found pus in antrum and overlying cells. Wound closed by the blood clot method. Did paracentesis of drum and removed faucial and third tonsils.

Culture showed the infection to be pneumococcic.

March 15: Wound has been dressed every other day, has healed by primary union. No complication.

DISCUSSION.

DR. J. LESLIE BRYAN said that this was the first opportunity he had had to observe the result of closure by the blood clot method and that he was agreeably surprised at the beautiful result in this case.

DR. HERSCHEL EZELL does not use this method. While it works beautifully where there are no complications, yet in the case of an infection it merely adds fuel to the fire. In this respect it resembles a cataract extraction done without iridectomy.

DR. FRED HASTY'S experience with this procedure has been a little more than fifty per cent successful. It is admitted by all surgeons who practice the method that it should not be attempted except in selected cases. He emphasized the point that there should be a certain amount of respect for the fact that soft tissues should not be lacerated by forceps. If it is decided that the blood clot closure is not a success, then the lower third of the wound can be opened, curetted, scrubbed out, and iodoform packing inserted and the wound allowed to heal as if the method had not been attempted.

DR. E. B. CAYCE believes the removal of the tonsils and adenoid of great value in any mastoid operation, but especially helpful in preventing a breaking down. In other words, letting the middle ear drain. He is inclined to think this procedure, as well as the thorough manner in which the operation was done, has some bearing on this case.

Dr. Wood (closing) stated that in order that the blood clot closure should be a success the following conditions must be met:

1. A patient free from tuberculosis, luetic, or any other general infection. In other words, a healthy patient otherwise than the mastoid trouble.
2. A thorough operation, removing all disease from the mastoid.
3. Paracentesis of the drum to allow free drainage from the middle ear out through the canal.
4. Removal of the diseased faucial and third tonsils at the time.

If these conditions are met he believes one can succeed in the blood clot closure, but if any of them is violated or overlooked failure will probably result.

Lymphosarcoma of the Pharynx. Dr. Eugene Orr.

Dr. Eugene Orr presented the case of Mr. C. C. R., aged 67, who was first seen by him on April 19, 1924.

Complaint: Difficulty in swallowing for the past three months. Swelling on the left side of neck for three weeks. This mass, he thinks, is smaller than it was one week ago, since he began applying tincture of iodine. There has never been any pain or tenderness. Nothing of importance in family history.

Personal History: Has worked at all sorts of jobs from doctor's assistant to oil driller. Denies venereal infection. Does not drink. Smokes moderately, though when at work he usually keeps an unlighted pipe in his mouth. Teeth have been bad for an indefinite period. Had five upper teeth on left side extracted two months ago. While at that time he himself had noticed dysphagia, the tumor did not attract the notice of the dentist. Other than the teeth, no history or evidence of pathologic condition of neighboring structures.

Examination: There is a firm mass along the left side of the neck from above the angle of the mandible to the level of the thyroid cartilage. It apparently involves, or is superficial to the sterno-mastoid muscle.

Pharyngeal examination shows a large, somewhat rounded mass larger than a lemon attached to fully three-quarters of the base of the tongue from the left side and to the lateral wall of the pharynx (only the lower portion of the pharyngeal tonsil is involved) and extending downwards further than can be determined by the palpating finger.

There is only a slight huskiness of the voice.

It seems probable that the tumor originated in the lymphoid tissue on the tongue, forming the lingual tonsil.

The following is a pathological report by Dr. Herman Spitz:

The histological structure of the present tumor presents a solid mass of small, deeply stained lymphocytes. These are mature, adult cells and suggest a longer duration of the growth than the clinical history. Sections from the center of the growth or from the neighboring nodes in which the advancing edge of the growth would be found, would show respectively, areas of necrosis and young, immature cells. Diagnosis: Lymphosarcoma.

The blood count is 95 per cent HB 4,800,000 RBC, 9,400, WBC.

According to Ewing this type of tumor, lymphosarcoma, arises in lymphatic tissue. Wherever located, with the possible exception of the spleen and bone marrow, the growth usually involves a group or chain of nodes which soon coalesce, forming a large irregularly lobulated mass. Growth is usually very rapid, and fatal cases are reported occurring within six to eight weeks. Some types seem to become chronic and are for a time apparently benign, but these as a rule, end in metastases and death.

Chronic infection is a frequent factor found in the etiology, but nothing positive is known as to its true cause.

Mallory includes lymphosarcoma, lymphomo, lymphocytoma, pseudoleukemia, lymphatic leukemia, and Hodgkin's disease under the general term "lymphoblastoma". His conception of this condition is, briefly: that these various names are applied to various stages of one condition.

Metastases occur by direct growth through blood vessel wall; by direct extension along the lymphatics; and by entering the general circulation through the thoracic duct.

Some regressions and cures are reported following excision, X-ray, radiation and after infectious fevers.

SUPPLEMENTARY REPORT.

May 19, 1924, Dr. Orr made the following additional report upon the above case:

April 22, patient had X-ray treatment (deep ray therapy) of 5 amperes, 200 volts, for one hour on the left side of the neck. This was repeated on the twenty-third and again on the twenty-fourth. Following these treatments the patient had considerable reaction, feeling quite ill for a couple of days. On the twenty-eighth, four days after the last X-ray treatment he had radium for thirteen hours, the treatment consisting of four needles of 12.5 mg. each inserted in the base of the tongue in the region of the lingual tonsil, and four needles in the enlarged gland on the left side of the neck.

Result: The pharyngeal growth has diminished in size until it is almost negligible, all that remains of the tumor at the present time being something about the size of a small almond. The patient has no difficulty in swallowing and no discomfort except that the throat has been somewhat sore from the X-ray. The pillars of the fauces look normal and natural. Following the X-ray treatment there was considerable exudate on the posterior wall, the appearance being similar to that of the throat following a tonsillectomy. While the gland on the outside of the neck has diminished fully two-thirds in size, yet it has not decreased with anything like the rapidity with which the pharyngeal growth has disappeared. There is considerable erythema from irradiation.

DISCUSSION.

DR. W. G. KENNON said that he had not seen anything prepared on the subject as to what effect the destruction of these growths has so far as the expectancy of the individual in concerned. He has not seen comparative records of the cases which were treated and those which were let alone. The best way of comparison would be between records of cases before radium treatment was instituted and those subsequent to it. It would be interesting to see whether it has any influence in prolonging life. Of course, it does have great influence on the mental as well as on the physical state of the patient. This man has had a considerable growth which in all probability would have been ulcerated, bleeding, and very painful. As it is, he has a practically clean throat. The treatment has certainly added greatly to the pleasure of this man's declining days, at any rate.

DR. M. M. CULLOM pointed out that the most serious feature about this case is the glandular involvement. He gathered from Dr. Kennon's remarks that the latter was not very optimistic as to the final result. While the treatment is, of course, in more or less an uncertain stage, yet he would not give up hope so long as a case showed such improvement as this one has.

DR. ROBERT SULLIVAN was especiallly interested in this case because of a similar one which he recently reported to the Society. His patient has had the same line of treatment by the same radiologist as Dr. Orr's patient, and there has been marked improvement.

DR. E. B. CAYCE said that as the X-ray and radium treatment of these conditions is comparatively new, it will require several years to compile tables and statistics by which one can arrive at anything like an expectancy. He reported improvement in a case of malignancy of the larynx which he previously brought before the Society. In this case only a slight amount of hoarseness remains.